MODELS FOR THE BLIND

The Ohio State Archaeological
and Historical Society
Columbus

Statewide Sponsor of

The Ohio Writers' Project

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MODELS FOR THE BLIND

Compiled by Workers of the Writers' Program
of the Work Projects Administration
in the State of Ohio

Sponsored by The Ohio State
School for the Blind

PREFACE

The Lincoln log birthplace and the Taj Mahal, an ox cart and a modern flying fortress, the Ohio Capitol and the National Capitol — these and many other things are all in Columbus, Ohio. They are housed in a big room out at the State School for the Blind. The blind and partially sighted children who play on the swings and teeter-totters just outside the windows of this room can tell you how many windows there are at Mt. Vernon, what the portico at Monticello is like, and even how the guillotine works. For, from time to time, in this room and in the classrooms, their fingers play over the models of these and other objects, and they learn the minute details of each.

The models were constructed at the school by a WPA project. Adding data to the research that guided this work, William Michel and John Batcheck compiled the basic manuscript for this book, written and produced under the supervision of Emerson Hansel. Stress in the writing is laid not so much on the construction of these models as on the supplementary material, which helps create a proper understanding of the history and structure of the originals.

W. G. Scarberry, Superintendent of the State School for the Blind, and his assistants have given valuable aid in the preparation of the book. The project concurs with Mr. Scarberry in the thought that this description of the models not only will serve as explanatory material for the teachers and children at the school, but also may prompt other institutions, of all kinds, to construct such models for educational purposes.

HARRY GRAFF, State Supervisor
The Ohio Writers' Project.

STATE OF OHIO
DEPARTMENT OF EDUCATION
E. N. DIETRICH, DIRECTOR

STATE SCHOOL FOR THE BLIND
W. G. SCARBERRY, SUPERINTENDENT
COLUMBUS

December 2, 1940

Permit me to say that the educational models used as teaching devices for the sightless have made this school outstanding in the field of tactual learning. This method and this distinction could not have been possible without the splendid services of the Work Projects Administration.

Educational models have opened up wider fields of learning for our pupils and have brought into their horizons of conception many objects that before had only vague and fantastic meanings. Consider for a moment how futile it would be to attempt to give a blind child an accurate conception of the United States Capitol, of Lincoln's birthplace, or of a skyscraper unless it were presented in the form of a model.

All of the models made and used at the Ohio State School for the Blind are accurately scaled and complete in every detail; thus, the teacher has no misgivings when she says, "Boys and girls, this is the way a Dutch windmill looks." She knows it is a true replica.

Much credit for the many fine models that we now have should go to O. J. Hill, Supervisor of Elementary Instruction, who has been and is the co-ordinator of the project that constructed them -- in this capacity, securing information from teachers and pupils as to what models are most desirable, and working with the local supervisor in order to have the ideas of the various staff members and pupils crystallized into tangible form. The entire staff of the school, the model-building project, and the Ohio Writers' Project are all to be congratulated for this very splendid contribution to the cause of the education of the sightless.

Very truly,

W. G. Scarberry

OHIO STATE SCHOOL FOR THE BLIND

A BRIEF HISTORY OF THE OHIO STATE SCHOOL FOR THE BLIND

In 1837, the year Braille first published his complete system for touch reading, the Ohio legislature passed an act establishing the first State-owned institution in the United States for the education of blind people. Schools for the blind in Boston, New York, and Philadelphia were supported by private donations and appropriations from State treasuries, but the Ohio State School for the Blind was actually the first in the Nation to be created and maintained solely by the State government.

The school resulted from the recommendation of physicians who met in Columbus in 1835 to discuss the erection and location of a "public asylum for the instruction of the blind." Following the legislature's suggestion in 1835, a survey of blind persons was made in the State. It was found that, in 55 counties, there were 202 blind persons. The estimate of the number of blind people in the State was 250. An act of April 3, 1837, established the institution and named the trustees, who were to secure the land and construct a building thereon. The trustees hired A. W. Penniman, a teacher from New England; and a temporary school was opened in rented quarters. Five pupils attended this first school. On July 4, the faculty and students were present at a meeting in the Presbyterian Church, where nine hundred persons were gathered to celebrate the sixty-first anniversary of the Nation's independence. By the fall of that year, the enrollment had increased to eleven.

An act passed in the legislature on March 11, 1843, authorized the trustees to admit free as many pupils as they thought proper; to keep in school two years longer those too young to be dismissed; and to admit free and retain for two years, to learn a trade, all indigent persons more than 21 years of age. On March 11, 1851, the distinction between indigent and paying pupils was abolished, and the maintenance of all pupils from Ohio was provided for at the public expense. By an act of April 28, 1852, all State institutions were placed under the control of a board of nine trustees. In 1856, the institutions were again put under the control of separate boards. In 1911, the Ohio Board of Administration was given charge of State institutions, and in 1921 the entire work of this board was taken over by the State welfare director, a member of the Governor's cabinet. Through the organized effort of interested persons, administration of the school was placed under the State Department of Education in August,

1927. The school has since made rapid strides toward a position of parity with all first-grade schools in the State and Nation.

About 1898, a significant change was made in the name of the school by an interested trustee, working along with others. Previously known as the Ohio Institution for the Blind, or more commonly as simply the Blind Asylum, the school now received a more fitting name, the Ohio State School for the Blind. In 1922, the State Department of Education granted the high school a charter with first-grade rating, thus enabling graduates to go directly to any State college or university without further preparation or examination. Courses of study at the school grew from a simple curriculum of literature, mechanical arts, and music to include three major departments — academic, music, and vocational — each with its own corps of teachers.

Immediately after their appointment in 1837, the commissioners reported that they had found a suitable plot of land just outside the city limits on the north side of the National Road; the land was to be donated by friends of the cause. Work on the school building began at once and was completed by 1839. Over-crowded conditions made it necessary to lay plans for a new building in 1869. The next year work was commenced on the present main building, which required four years to complete. In 1933 plans were made for new dormitories necessitated by the fire hazards and weakening supports in the old building. Two new dormitory units were opened in 1935. They are fireproof, sanitary, modern buildings in which surroundings meet present-day standards for the health, social life, and educational pursuits of the residents. The main stone building now houses educational and administrative personnel and has been fireproofed and modernized.

In a little more than a century the Ohio State School for the Blind has grown from a school with one teacher and five pupils to a school with a faculty of 37 and an enrollment of 270 pupils. The following superintendents have served the school since its inception: William Chapin, 1840-1846; A. W. Penniman, pro tem, 1846-1848; George H. McMillen, 1848-1852; Rufus E. Harte, 1852-1856; Dr. Asa D. Lord, 1856-1868; Rev. George L. Smead, 1868-1885; Henry Snyder, Jr., 1885; Dr. H. P. Fricker, 1885-1886; Col. C. H. Miller, 1886-1890; Dr. H. P. Fricker, 1890-1892; Dr. S. S. Burrows, 1892-1896; Rev. R. W. Wallace, 1896-1900; Rev. George L. Smead, 1900-1905; Dr. Edwin N. Brown, 1905-1907; Edward M. Van Cleve, 1907-1914; H. C. Maurer, acting superintendent, 1914-1916; Charles F. F. Campbell, 1916-1919; J. Frank Lumb, 1919-1933 and W. G. Scarberry, 1933 to the present.

INTRODUCTION

The word, *model,* suggests some toy-like replica of an object. Lately used for decoration and as hobbies, models have come to be associated with the impractical. In all fairness, let us correct this impression. Through the long centuries models have been employed as aids in planning new structures and in inventing new devices. Architects, decorators, dressmakers, manufacturers, inventors, and all others helped by three-dimensional foresight have turned to the model to envision finished work. At the art show held in Milan, Italy, in 1939, the genius of Leonardo da Vinci was revealed by 60 wooden models made from his original sketches. Included in the display were models of a steam gun, an airplane, and many surprisingly modern inventions.

Although most of us have seen model displays in the schoolroom or in a museum, this country has lagged greatly in the application of these visual aids to the educational field. It is not hard to understand the value of models to the seeing person, but let us try to realize their usefulness to a blind person. We know that one picture is worth many words. To the blind person a model is a picture that can be explored through the sense of touch in the same way that a seeing person studies a picture. Thus in our hurrry-up modern life the blind person is now able to assimilate more quickly the facts of the world about him by means of models, Braille, radio programs, and recordings. The space required for a Braille library limits its use; for example, the Bible in English Braille comprises 25 volumes, and in Japanese Braille, 34 volumes. Class discussions built around models arouse interest, are speedy, and encourage fuller subject treatment.

Realizing the value of these models, Ohio people are pioneering in this new way of educating the blind. Exact, durable, built-to-scale models have been used with phenomenal success in the classrooms of the Ohio State School for the Blind. When one adult blind person visited the model room, it was discovered that his imagination had pictured a lighthouse as a light hung at the top of a pole. He was surprised to find here a complete answer to all his questions on the subject. It remains to be discovered what are the limitations, if any, of this method. The following material is submitted as a guide to be used in the building and study of models, and as a record of the achievements at the Ohio State School for the Blind.

SUGGESTIONS FOR CONSTRUCTION AND USE OF EDUCATIONAL MODELS

To realize the most good from the use of educational models, it is essential that the teacher be thoroughly familiar with the subject of the model and with the model itself before it is presented to the class. There are many things of interest concerning the history of a subject, and others in regard to the model, which the teacher should know — regardless of whether these facts are actually used in class. The effectiveness of the lesson will be greatly enhanced by this reserve store of knowledge

and the confidence it will engender. In some models, it was impossible to reproduce certain small details that nevertheless are an important feature of the discussion of a subject. For example, a pupil may ask whether horses were kept in the shed-like building connected with Salisbury Cathedral. The reply he receives to this query may well set up in him a lifetime reaction to the subject and most certainly will affect his attitude toward the teacher and the methods. Brief information concerning dimensions and a scale for comparative study are parts of each model. Thus a fairly accurate idea of the original is gained through the use of vertical and horizontal axes and scale measurement.

The manner of the presentation of the models is left to the discretion of the teacher. Some teachers may wish to build an approach to the study of the model by first reading all available material about the original and then developing the lesson after the model is studied. Others may wish to present the model first in an exploratory or laboratory procedure, allowing pupils to ask questions as they investigate. The merit of these plans varies with the nature of the model; and no doubt other methods of approach will be found that are just as effective.

All the models described in this book are the result of research, design, and construction carried on by employees of the Work Projects Administration. The models have been built of durable materials to withstand considerable ordinary usage, and are already considered a permanent feature of the educational system at the Ohio State School for the Blind. Average labor cost for the larger models was $45. A special room has been provided for storing the models, which the teacher may borrow and have wheeled to her classroom. When returned, they are charged off her account. The whole process is similar to that used in libraries; a reasonable time limit has been placed on the loan of the models so that every teacher may have the opportunity to make constant use of them. The following material accompanying the model illustrations is meant to stimulate further research rather than to become a text for model study. If used in the classroom, it should be translated into simpler terms and expanded as desired.

Of interest to most people will be a description of some of the methods and materials used in building the models. In the case of the frog model, a study was made of a live frog. Excellence of the model more than repaid the extra care taken in its making. Research in connection with the architectural models entailed a careful use, in many libraries, of all source material — both the obvious and that hidden under unexpected classifications. Careful weighing of all written material for authenticity was necessary, especially in the consideration of such subjects as ancient monuments. Precisely the opposite difficulty was encountered in the research on the historical subjects, which encompass, instead of a dearth of material, a huge amount of written words the gist of which had to be

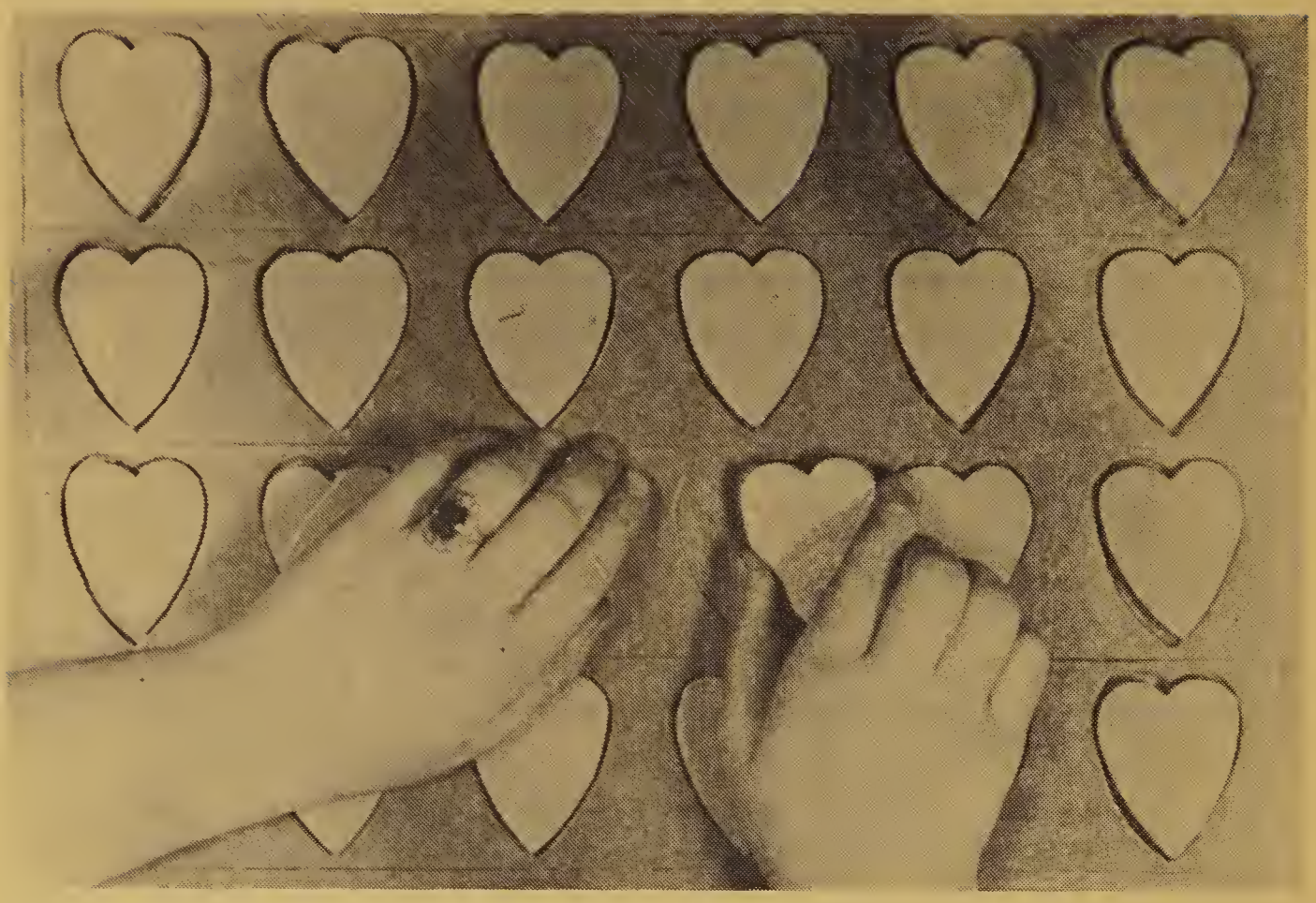
extracted to obtain an average, or perhaps composite, picture of the subject, so that the model would be truly representative.

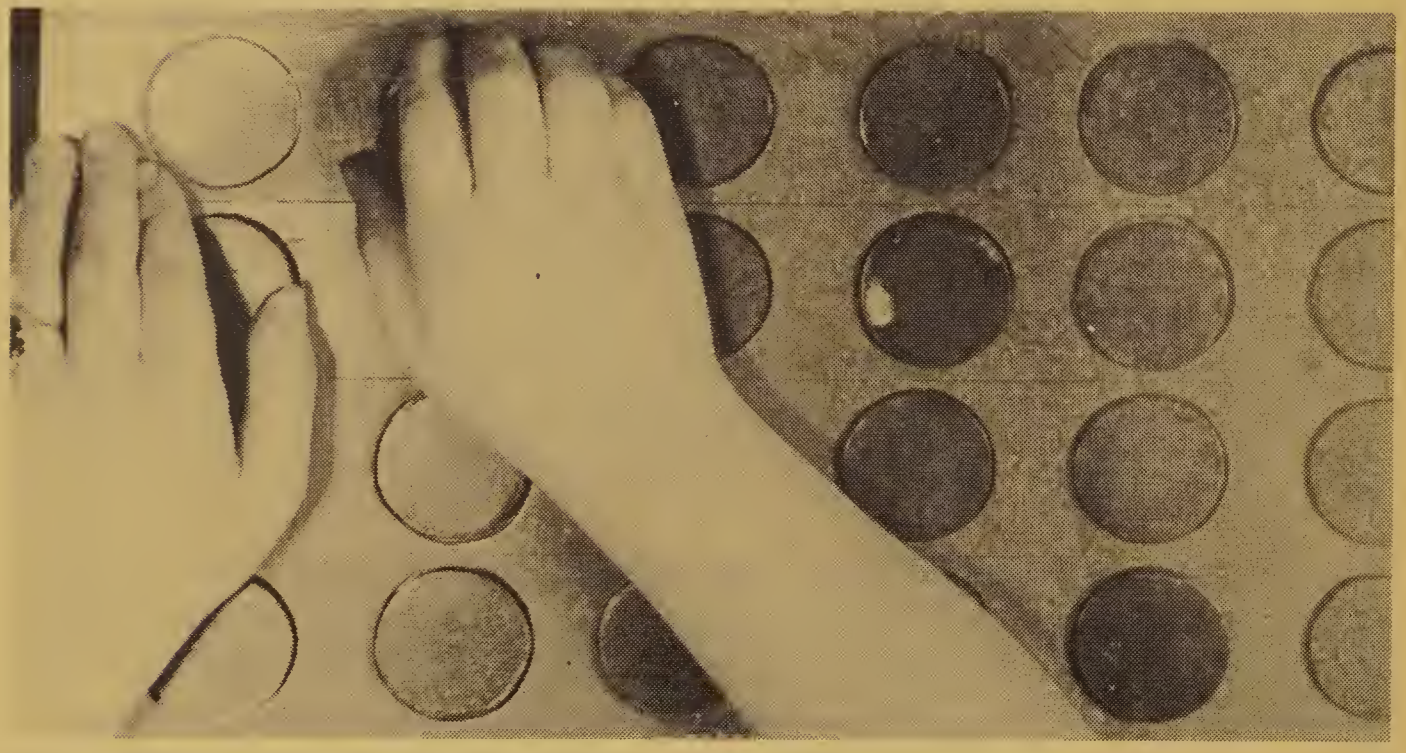
To simulate masonry in actual construction of such models as the Arch of Titus, Mount Pleasant, and Salisbury Cathedral, fine sand was applied to the fresh paint, giving the feel of stone. Where brick was to be shown, lumber was used in which horizontal indentations were made with a saw, and the staggered indentations of brick ends with a small chisel tapped lightly with a hammer. Foundation stones of buildings, such as those in the grist mill, were made quite successfully by moulding glazier's compound into desired shapes. Roof shingles were indicated by thin pieces of wood fastened to heavier underpieces cut the full length of the roof, overlapping in the manner of asbestos roofing now on the market.

Grass was indicated by sawdust, dyed green, and applied to wet paint with or without a glue base. In the instance of the adult butterfly, chamois was painted in desired colors and glued to a sheet-metal base. Thus texture was gained and durability not sacrificed. To make the Ohio farm, rope ends were used for shocked grain, cloth ends dyed green for young crops, fibers tied to the underside of the board in brush fashion for mature grain crops, and screen wires shaped into fences and gates. Screen wire has many uses. Coarse screen wire served well, in many cases, for window panes where windows were too small for the use of wood or other worked material.

Dowel pins, sharpened at the ends, were made to represent the logs and palings of the Frontier Town. Common pins were invaluable in suggesting balustrades, the China Clipper's water spigots, and other details that would have otherwise been impossible to make on such a small scale. Glass was used very little, but it did enter the construction of dome lights and of windows where it was desired to bury an electric light bulb in the model so that night effects could be gained to add interest. In mechanical models and models of vehicles, where movable parts are so important a feature in demonstration, hinged movable parts were actually built into the models wherever possible. Examples are the aelerons and rudders of some of the airplane models.

Thus we see that the three most important materials used were wood, metal, and gesso, in that order. Italians first used the word, *gesso,* to denote plaster of Paris when used as a background for painting or as a medium for modeling. The gesso used on this project is made from a mixture of putty or modeling clay and glue, varnish, and other ingredients. It can be readily shaped, but when dry is almost unbreakable. It was used to indicate sculpture, human figures, natural objects, and any features which had to be molded to form. In many cases, an armature of newspapers, wood, or other materials formed a foundation for the gesso. All types of wire, rubber bands, brads, glue, carved wood, and gesso on metal or wood were employed.





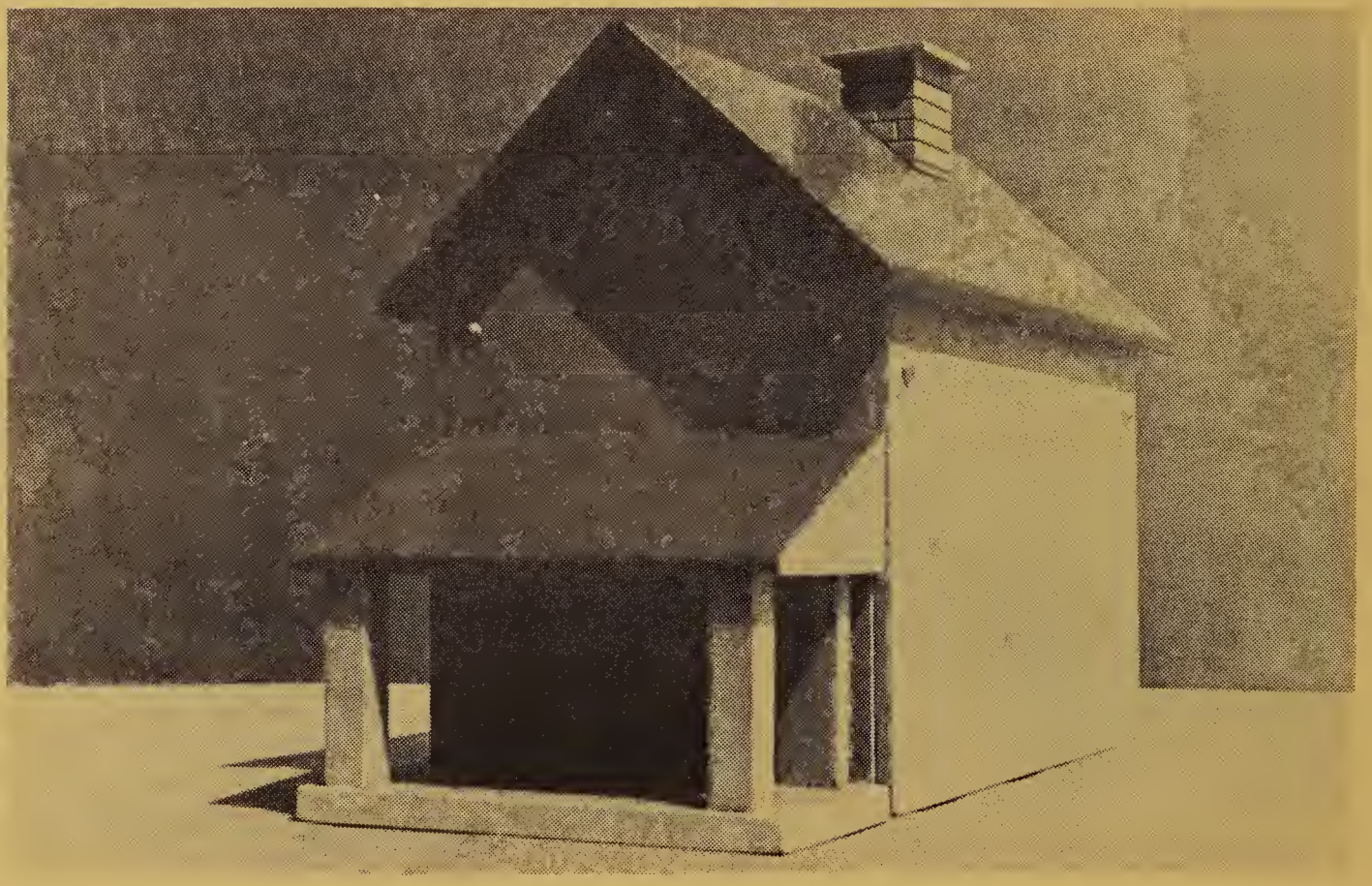
ARITHMETIC BOARDS

Width 14", Height 9½"

ARITHMETIC BOARDS

The neat, solid wood frames, 13 by 11 inches, and 13¾ by 9½ inches, have indented pockets, into which fit the 24 crescents, diamonds, circles, squares, stars, or hearts used to teach problems involving arithmetic. The figures are made of compressed wood and painted in a primary color that contrasts with that of the board. The four different lines of figures permit instruction in multiplication, addition, subtraction, or fractions, the answer appearing on the line below the ones where the problem is set up. The process is much the same as though paper and pencil were being used, except that units are more easily understood than their numerical symbols. Both board and shaped units are easily handled by small fingers.

BOLTED BLOCKS



BOLTED HOUSE

Length 18", Width 7", Height 12"

BOLTED BLOCKS

The bolted blocks comprise sets of square wooden blocks and steel bolts. The bolts fit into holes in the center of the blocks. A set consists of three blocks of equal size and their corresponding size of bolt. When not in use, the blocks and bolts are contained in small boxes made of plywood.

The object is to find the set of three blocks of the same size and with the same sized hole, and then bolt these together with the bolt of the correct size. The blocks and bolts help perfect manual dexterity and coordination.

BOLTED HOUSE

The bolted house model is designed to improve and demonstrate manual dexterity and coordination. It is a representation of perhaps the most simple of the small, two-story gable houses that are common in almost every American neighborhood. Even its small front porch is typical of those familiarly seen attached to this type of house.

The models have been made small so that a child can manipulate their parts. Each part, such as walls, roof, floor, and chimney, is complete in itself, but fastened to the other parts by different-sized bolts and nuts. Thus, the chimney can only be fastened onto the roof with a certain-sized bolt, and only after the roof has been bolted in place. Correspondingly, the roof is not bolted on until the walls have been bolted together; the walls, in turn, must be bolted previously to the floor pieces.

There are two of these models. One has its walls painted light gray, its roof green; the other has white walls and a blue roof. Both have chimneys that are painted red. All their parts are made of wood. There has been no attempt to simulate the exact details of a house, such as windows and doors.

BRAILLE CLOCK

Length 12", Width 12", Height 6½"

BRAILLE CLOCK

The model Braille Clock is similar in appearance to the square display clocks that telegraph companies rent to customers with a guarantee that they will keep accurate time. These clocks are electrically operated and are connected by wire with a master clock at the telegraph company's main office, which in turn is assured accurate timekeeping because of wire connections with the United States Naval Observatory. These clocks are a familiar sight in public places. A clock of the Western Union Company is on a wall in the reception hall of the Ohio School for the Blind. This clock assures exact time for operation of the institution and its activities, and many visitors set their watches according to this unfailing timepiece.

The model clock has Braille characters on its face. Since it is a demonstration clock, the foot-square box, or clock case, has no apparatus inside, but the hands can be moved from the rear of the box by a knob. Operated in this way, the minute and hour hands revolve in their correct ratios. The minute hand revolves around the face of the clock every time the hour hand completes a movement from one hour numeral to another.

In addition to this master Braille clock, there are 12 Braille clock faces to demonstrate the operation of hour and minute hands.

BUSY WORK PATTERNS

MATHEMATICAL MODELS

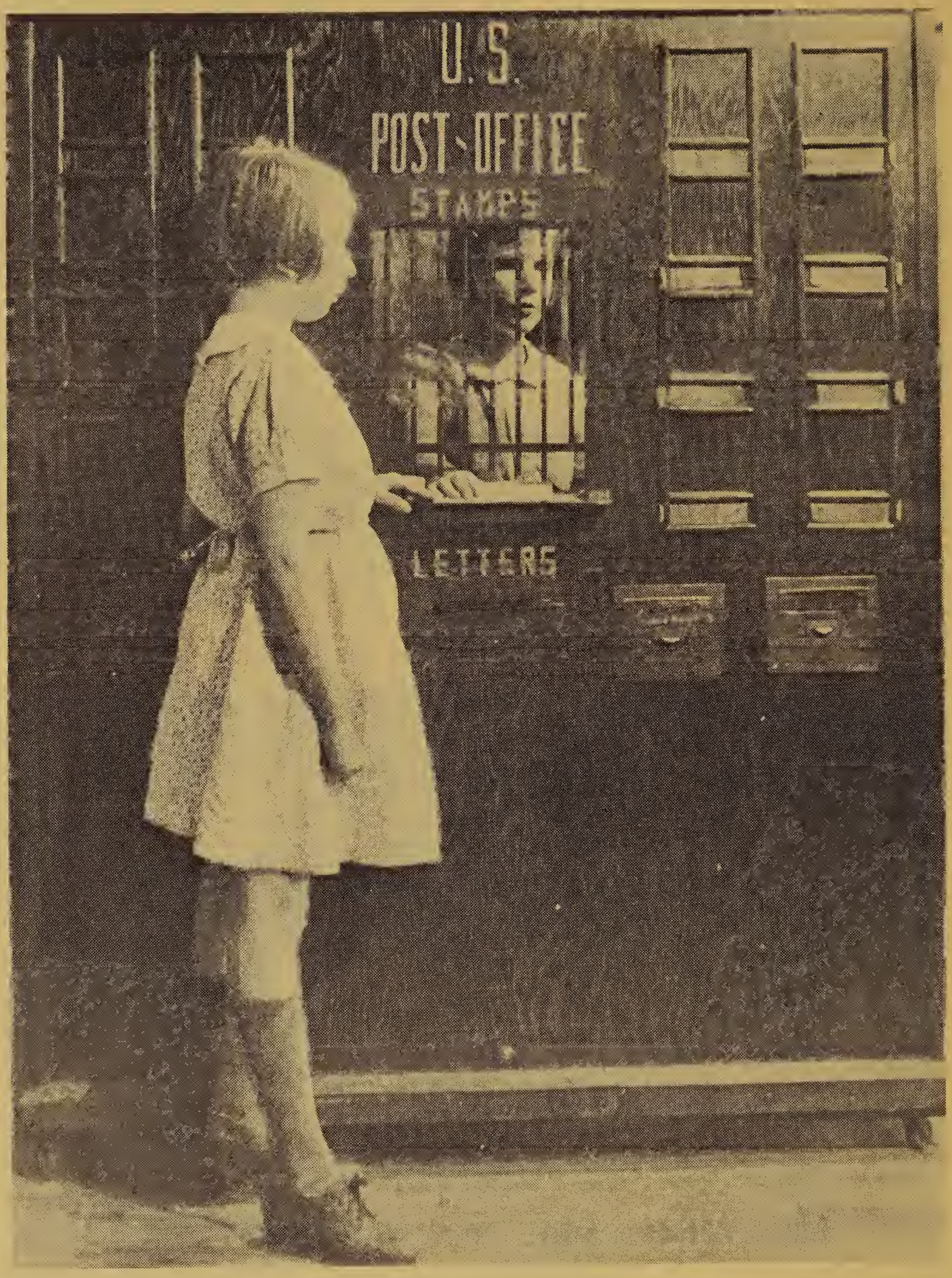
BUSY WORK PATTERNS

Simple, attractive open-work designs have been cut into masonite rectangles. The resulting stencils are then placed over a piece of copper sheeting, and the pupils tap a counterpart of the design by working through the stencil with a dull tool. Insulating pads for tables have been contrived for Christmas gifts, but many other uses can be made of the patterns, depending largely on the ingenuity of the teacher. The roughed-up, hammered effect on the metal presents a pleasing contrast to the plain outlines.

MATHEMATICAL MODELS

There are sets of blocks to describe a "plus B plus C squared" and a "plus B plus C cubed." There are forms to illustrate a scalene triangle, a trapezoid, equilateral triangles, isosceles triangles, a parallelogram, a rhombus, a trapezium, and simple squares and rectangles. There are models to show ellipses and the bisection of a circle, and to demonstrate the Pythagorian theorem. Hypocycloids, volutes, regular and irregular polygons, and prisms of various kinds are also demonstrable by models.

This numerous group of models was made from pine, shellacked and waxed to a fine finish, with metal tape or other material used where needed. Several sets of the simpler figures were made from masonite or compressed wood. Each set has a rack or box, so that, after the class has used the figures, they may be immediately gathered and stored away safely. The racks and boxes are so arranged that, if a piece is missing, the loss becomes apparent at once. These models are extremely useful, and new ones are being added continually to the list.



POST OFFICE

Length 44", Width 49½", Height 62½"

POST OFFICE

The post office is the third in this group of settings used to dramatize various phases of domestic life. To add to the realism, a mail box is affixed to the cottage. The simple, four-sided, four-foot-square post office has a window with adjustable grill for the transaction of business, a slot to receive outgoing letters, and frames with Braille name plates on the boxes. Merchants' mail is relegated to four drawers. Postal employees enter through a side door. Under the window, they find a shelf for work purposes, and above it, and on each side, are the pigeonholes into which mail is distributed. A metal rack on casters holds the mail bag while sorting is in process.

A result of the construction of this post office has been an increased interest in letter writing; three of the primary departments exchange letters.

SECTIONED APPLE

Width 3½", Height 3"

SECTIONED APPLE

The most successful teaching aid yet devised for the beginner in arithmetic is the sectioned apple. The difficult task of imparting a proper conception of fractions to the blind student is hereby greatly simplified. The model consists of a very realistic apple, which unfolds on hinges to show halves, quarters, and eighths. It is durably made of wood (painted red), and there are no parts to be lost.

GENERAL TEACHING AIDS

OHIO STATE SCHOOL FOR THE BLIND

Length 6', Width 74", Height 45"

THE OHIO STATE SCHOOL FOR BLIND

At East Main Street (route of the old National Pike through Ohio's capital) and Parsons Avenue, an imposing group of buildings stands in a nine-acre treed expanse of grounds. A gently curving drive leads to the large, venerable brownstone main structure, which faces Parsons Avenue. This building is a familiar landmark of Ohio's education of the blind.

In 1869, when the battle drums and flags of the Civil War had hardly been laid away, the trustees of the Ohio State School for the Blind recommended to Governor Rutherford B. Hayes, who was later to be President, the erection of a new building for the growing institution. On May 6, 1869, the Ohio Legislature authorized its erection at a cost of $275,000; additions brought the final cost to $367,862.

William Tinsley, Cincinnati architect, drew the plans for the building. When it was completed, in 1873, many people considered the massive structure, with its turrets, broken facade and roof lines, and central tower, more elegant and impressive than the stately Ohio capitol. It was built of native Ohio sandstone in the style of the late Elizabethan period; the stone has aged to a brownish tint.

The building is large — 310 feet across the front. Its central part, including the mansard-roof story, is six stories high; the original tower reached still higher. In its principal sections, the roughly rectangular building, including the story under the mansard roof, is five stories high. At the rear it is indented with two main courts, the original back wings, now partly built in, outlining the letter E.

The interior of the structure is dignified and distinctive. At the end of the marbled and tiled entrance hall is a wide stair; the stately upward progression of its landings and ballustrades is emphasized by ornamental iron work. Spacious halls lead to the various sections of the building.

Extending in elongated, haphazard fashion from the rear of the central section, additions have been made at various times to house heating, laundry, and repair departments. Separate buildings contain a carpenter's shop, garage, and greenhouse. Towering over these are a brick smokestack and a standpipe.

The modern dormitory buildings, which flank the main structure on the north and south and are connected to it by passageways, were added in 1935. At that time, since the old building had grown decrepit in parts, it was remodeled. The tower cupola and turrets were removed.

The model depicts, in accurate scale, all the campus structures, walks, and landscaping, including the exact positions of the numerous trees.

THREE ROOM COTTAGE

Length 10'3", Width 8'6", Height 8'6"

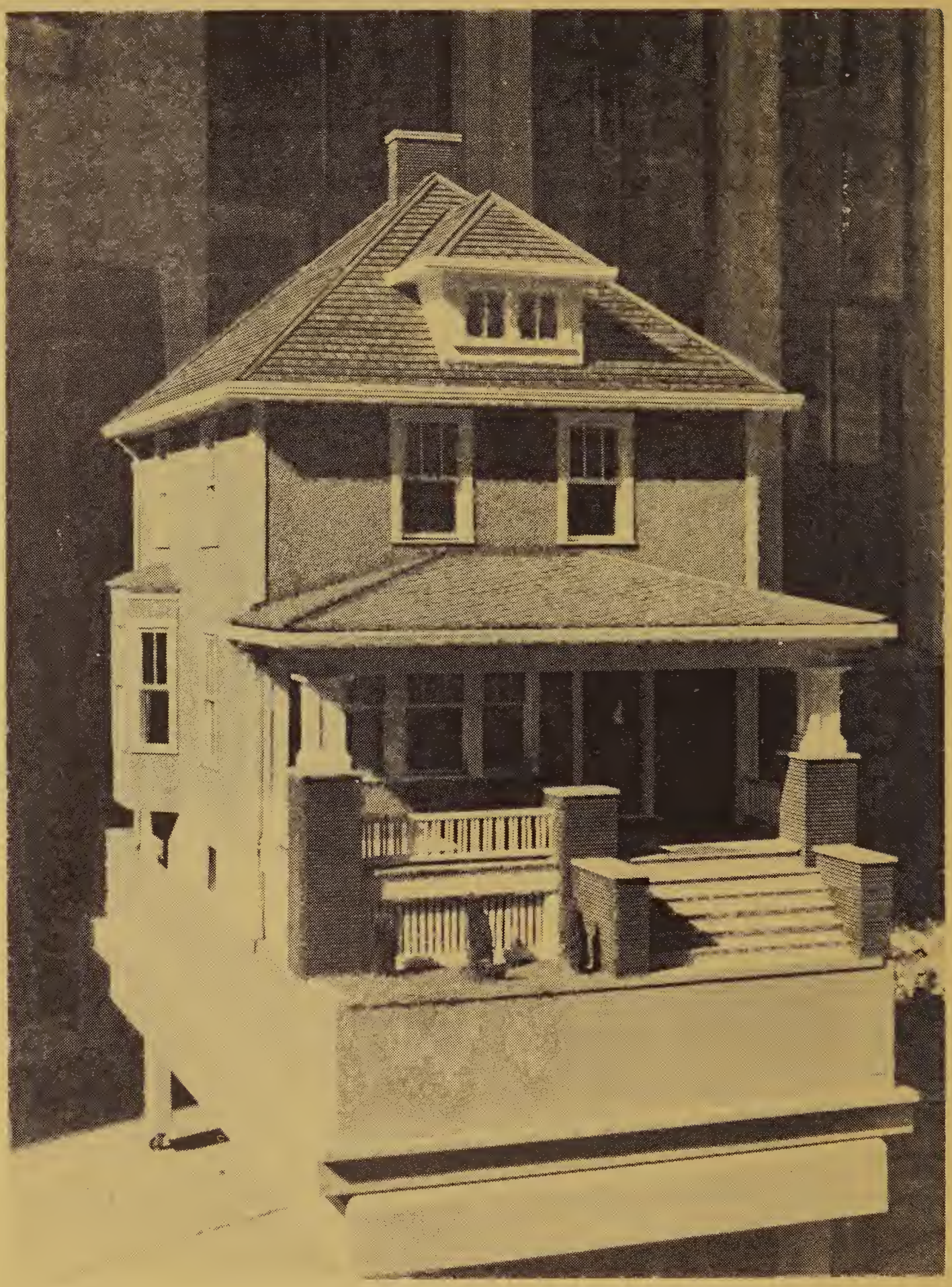
THREE-ROOM COTTAGE

In the first-grade room, there is a three-room cottage. The kitchen is four by three feet, the bedroom is three by three-and-a-half feet, and the combined living and dining room is nine by three feet.

This cottage has many uses. The children learn to do simple cooking and light housework, such as dusting, washing dishes, setting the table, and the like. The kitchen stove has an electric grill, built in for cleanness and safety.

The teacher also uses the cottage as a stimulating setting for "busy work" projects, such as molding vases from salt and flour, or as a simple class project, involving, for example, a simple description of the tiny house.

ARCHITECTURE



TAKE DOWN HOUSE

Length 6'½", Width 2'11", Height 5'

TAKE-DOWN HOUSE

The Take-Down House is more than a toy that would delight the heart of any boy or girl; it illustrates in great detail the many parts of a house. As tall as an average eight-year-old child, the house requires little stooping to examine its interior. When it is placed on a low table, all its parts, exactly like those of a grown-up house, are readily seen. Furthermore, the sides, roof, and sections of the house can be taken down to reveal its every detail — whence comes the name, Take-Down House.

The house is typical of American residential architecture. Its square floor plan, two-story height, and hip roof with dormer windows, are features of houses in almost every neighborhood. The cornice gutter of the main roof is also a familiar part of this type of house; it catches the roof rain water and conveys it to the ground in the tin drain spouting. Its roof of wood shingles is also common, but the cheaper composition shingles on the roof of the front porch and on the dining-room bay roof are more frequently used. Metal shingles like those of the back porch roof are rarely seen. The large front porch of the Take-Down House, with its pretty columns of brick and wood and its wooden balustrades, is the kind found in almost every American community.

People take many features of a house for granted, but few have examined some of them closely enough to understand their operation. Windows, for example, open and raise with ease because of concealed weights and pulleys that are enclosed at the side of the window sash. The model discloses these.

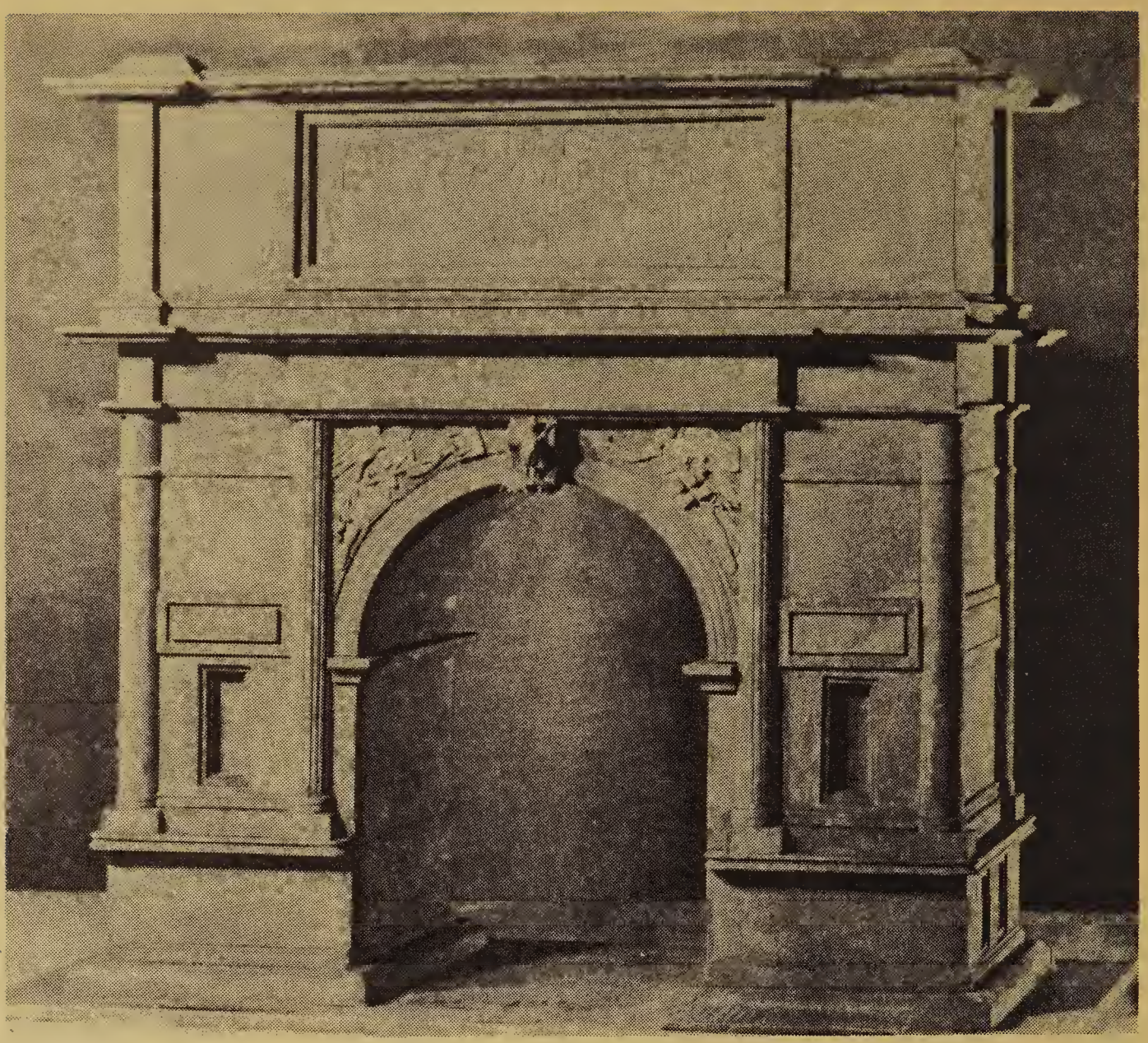
If the model is lifted from its brick foundations — a feat that two persons can easily perform — the entire basement is exposed. Here is a hot air furnace of the type that heats many homes. Accurate in every detail, it has pipes or vents that take heat to every room, regulators, a smoke vent to the chimney, and a cold air draft that permits the furnace to breathe the air it heats and sends throughout the house. The basement has also a laundry tub and an electric panel board, containing fuse box, switch, and meter.

When the house is returned to its foundation and a side pulled away, the first-floor parts are readily apparent. In the kitchen is an exact replica of a sink. Opening from the kitchen is the dining room, with a jutting bay window. The largest room is the living room, that extends across the front of the house; it has a fireplace.

A stairway leads upstairs. Here are two bed rooms, closets, and a bath room that contains the equipment of a modern home. Another stair leads upward to the usual attic.

The supporting framework of a house, including the upright wall studs, the horizontal floor and ceiling joists, and the sloping roof rafters, can also be examined by the removal of parts of the Take-Down House.

ARCHITECTURE



ARCH OF TITUS

Length 39", Width 17", Height 34½"

ARCH OF TITUS

As a young man, Titus served creditably with the Roman army in Germany and Britain, and had command of a legion under his father, Vespasian, in the "Jewish War." When Vespasian was called home to become emperor in 69 A.D., Titus was left to carry on the siege of Jerusalem. The city was captured in 70 A.D., and Titus joined his father in Rome, where a great celebration honored both men.

It is the story of this campaign and its triumphant conclusion that is recorded in relief on the Arch of Titus. Among the art wonders of ancient Rome are two panels of this sculpture. One shows Titus' entry into Rome, with the goddess, Roma, leading the horses of his triumphal car and groups of civil and military officials following in his train; the other depicts the spoils of war borne on floats and carried by laurel-wreathed citizens, with a table of show bread, a seven-branched candlestick, and captured military standards discernible against the background of the Campus Martius gate.

Vesuvius erupted the year Titus was crowned emperor. He supervised relief at stricken Pompeii, and, returning to Rome, found that a three-day fire necessitated additional relief measures there. The empire enjoyed comparative peace in his short reign. He contributed much-needed reforms in the central government and was showing great promise as a ruler when he died, in September of 81 A.D., the year his memorial arch was built.

In our modern cities, the monumental arch is set at the head of a boulevard or in some focal position, such as that of New York's Washington Arch, Paris' Arc de Triomphe, and Berlin's Brandenburger Tor. In the ancient world, however, the arch was placed in a position subordinate to other buildings, much as we place statues or plaques. Ceremonial processions might pass through them, but they were not meant for axes in a planned order. Titus' arch, relic of the empire, stands not far from the old Roman Rostra, birthplace of modern representative government.

Exemplary of the best in the Composite style, the arch is remarkable for its exquisite capitals, the normal Corinthian entablature of which suggests the origin of the style, and for its splendid bas-reliefs. It is 47 feet high and 44 feet wide, with a deep-paneled barrel vault 18 feet across. Columns, the originals of which are fluted and the restored ones plain, are semi-engaged — making them an integral part of the structure — and set upon engaged extensions of the base that lend an effect of great solidity. Richly decorated keystones hold statuettes of Roma and Fortuna. Winged female figures, symbolic of victory, fill the triangular spaces above the archway.

ARCHITECTURE

BLOCK HOUSE

Length 23", Width 23", Height 15½"

BLOCKHOUSE

The blockhouses of American frontier posts were reminiscent of Roman military towers. They were usually built in a square shape of rough-hewn logs, with an overhanging second story, from which rifle fire could be placed in all directions. In time of emergency, a large blockhouse could accommodate as many as a hundred persons. The ladder was pulled up through the trap door, leaving no means of ascent for the enemy. Loopholes were the only openings to the outside, and, in the event the enemy crept to the base of the walls, holes in the floor of the overhanging portion permitted close-range fighting. Blockhouses formed lines of outposts in the wilderness. They allowed small bands of soldiers to patrol a large territory, for the soldiers could live off the countryside, safe from ordinary Indian raiding parties in times of quiet, or retire to their log forts in times of trouble.

When settlers began to arrive and palisaded towns grew up, the blockhouse was built in a corner of the town, much the same as was the *donjon* of French and English feudal castles after the Norman conquest. The blockhouse was then used as a storehouse until trouble threatened, when it became a lookout post, and, if necessary, a place of last defense. On a dark night, a volunteer might be sent out to secure water from the supply always present in a fortified town, or he might be dispatched to the next post for reinforcements and supplies.

As additional settlers came and more lasting building materials were used, blockhouses were made of brick or stone. Later still, sheet metal was sometimes used in their construction. The last successful military use made of blockhouses was during the Boer War, when England shipped them to the front in sections, to be assembled in South Africa. When high explosives came to be used in warfare, the blockhouse was put underground and became a dugout.

CAPE COD HOUSE

Length 26", Width 34", Height 23"

CAPE COD HOUSE

Throughout the country, whether it be in a village or metropolitan suburb, along a country lane, or on Massachusetts' famous cape, the Cape Cod type of house is as graceful as the newest architectural style and as charming as the oldest. Its origin, most likely, was in England; in form and outline, it resembles the thatched stone cottages built during England's feudal period by weavers, fishermen, peasants, and others who lived a simple life of toil. When some of these folks came to America, it is natural that they gave to the most common building material, wood, the lines and forms with which they were familiar.

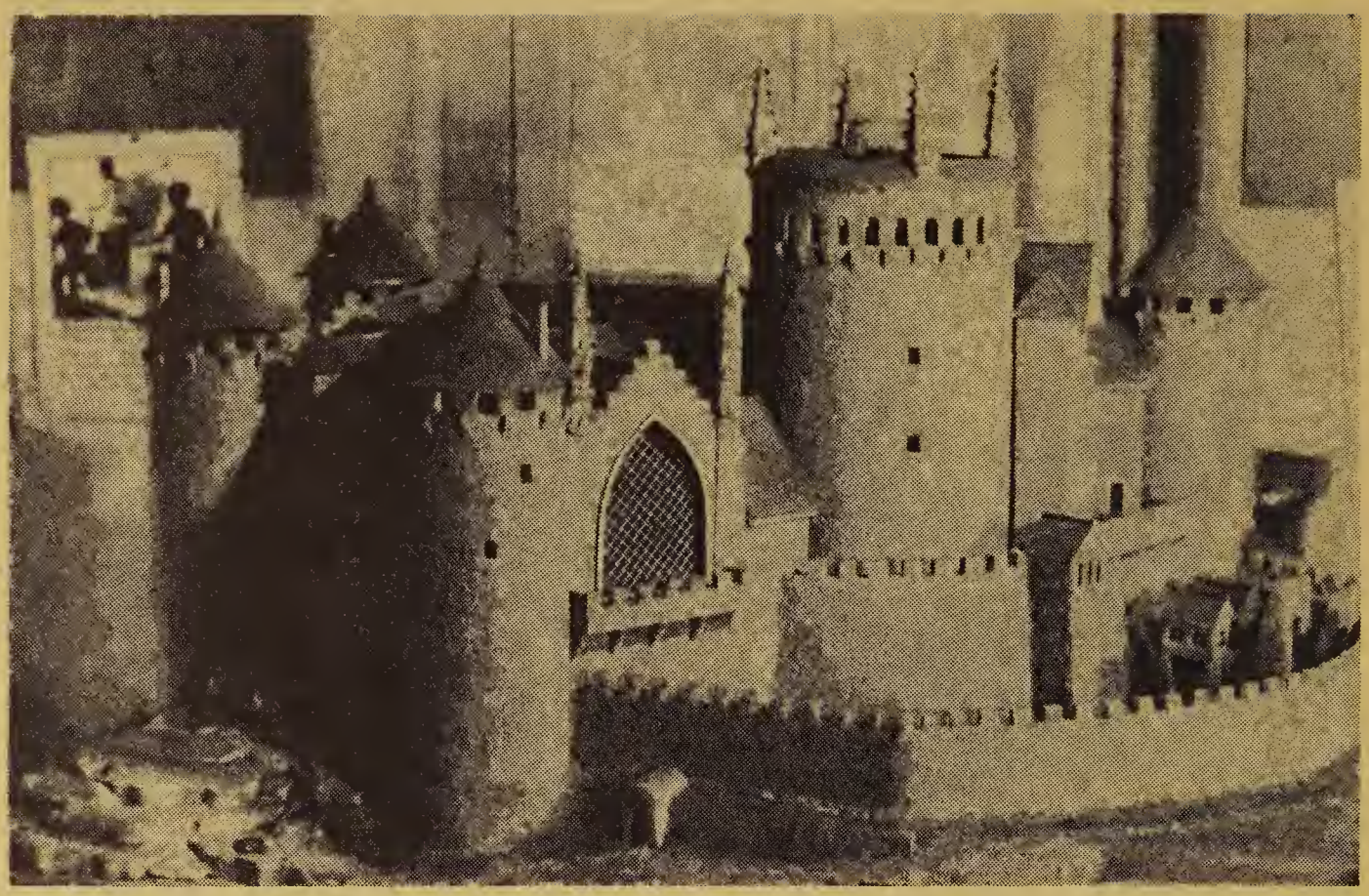
As the name indicates, however, the Cape Cod house has largely evolved as an expression of its American environment. Its simple appearance, long, low eaves, and one-and-a-half story, invariably wood-clad from foundation to roof shingles, were excellently suited to its first location, Cape Cod. As terrific gales swept the Atlantic at this point, the Cape Cod house presented less obstructions to the perilous "blow-ups" than did the usual two-story houses of New England. Although they withstood the storms, however, these first Cape Cod houses were eventually towed across the bay to sites in towns.

Another reason for the simplicity of the Cape Cod architecture lies in the fact that fishermen could not afford to build more elaborate houses. Apparently the only decorative flavor was provided by the shutters; and even these had a practical purpose: they protected the windows when a storm was "blowing."

At Provincetown, on the Cape, the oldest Cape Cod house is the one known as the Hooked Rug House, thought to be more than 150 years old. One of its early owners, Seth Nickerson, was a member of Washington's Continental Army.

The model illustrates a modern version of the Cape Cod house that retains several main features of the style. Thus, the story-and-a-half, with rooms under roof, the low foundation line, and the door stoops are in the Cape Cod tradition, as are the 12-paned windows, flanked by wooden shutters. The principal departures from the pure Cape Cod style are the dormer windows in the roof, added to increase the space and light of the half-story under the roof. The brick foundation, the sun parlor, the glass, the sashed door (replacing the usual Cape Cod's wooden door), and the slightly raised stoops are modern additions. This modernized Cape Cod house is typical of many homes built recently in this country.

ARCHITECTURE



COUCY CHATEAU

Length 46½", Width 37", Height 27"

COUCY CHATEAU

In a little village of northern France there existed, before guns of the World War destroyed it, a famous feudal chateau. Here the sires of Coucy lived from the time Enguerrand de Boves, founder of the family, seized the fief by force of arms in the eleventh century, until Marie, daughter of the seventh Enguerrand, sold it to Louis, Duke of Orleans, in the fifteenth century. Famous men of this line were Thomas de Marle, Enguerrand III (the Great), and Enguerrands IV, VI, and VII, the last of whom married the daughter of Edward III of England. The Chatelain de Coucy, famous in legend and for his songs, was castellan from 1186 to 1203 at Coucy Castle. In 1492 the castle became crown property; in 1652 it was finally dismantled by order of Mazarin.

Roman *castella,* or detached military posts, were the forerunners of the feudal castle. They were built of the timber so plentiful in northern Europe — with palisades and towers for defense. The Frankish fortified villa was a quadrangle like the Roman camp, having, in addition, a ditch (or moat) outside and a central keep, or *donjon,* atop a trench-protected mound that in emergencies became a place of last defense. After the Norman conquest in the eleventh century, castles in France and England were built with the keep at the edge of the enclosure to insure outside communication, even though the enemy held all but this tower. Late in the eleventh century, stone masonry began to displace wooden construction.

Best examples of the development of the military tower are to be found in fortified city walls and in such donjons as the White Tower of the Tower of London, that at Pierrefonds, and the round tower at Coucy. Coucy Chateau was built, rebuilt, and added to, until it became the most remarkable privately owned fortress of the Middle Ages. Covering an area of 10,000 square yards, it is surrounded by high walls and defended by a spring-fed moat. Four towers rise beside the *donjon,* which is 210 feet high and 100 feet in diameter, and the walls of which are 34 feet thick. As one enters the gate, the *donjon* is to the left, the chapel beyond, and the living quarters of the court directly ahead; the living quarters for the workers and the quarters for home industries and arts are to the right. This was a self-contained community, able to defend itself and keep traditions and the arts alive during a comparatively stultifying period in world history.

CORINTHIAN ORDER

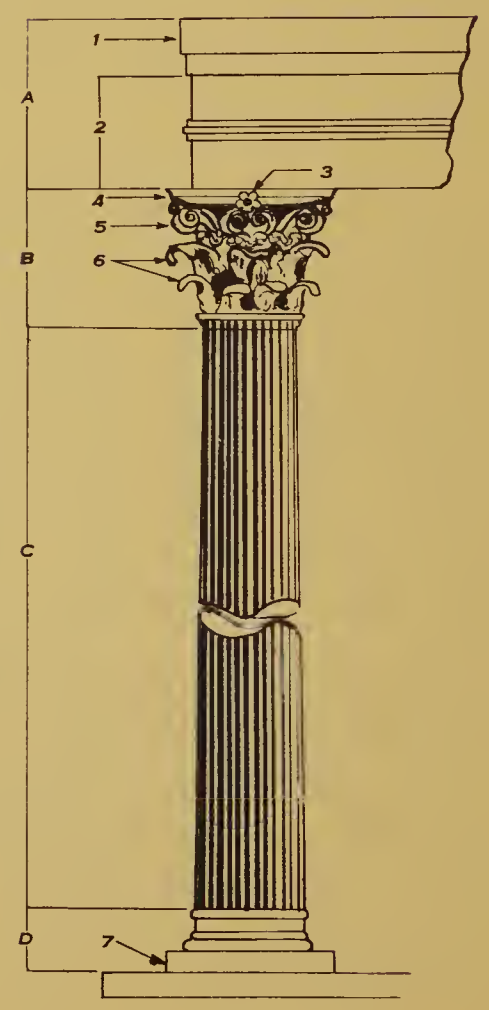
Length 20", Width 20", Height 61"

A. Entablature
   1. Cornice
   2. Architrave

B. Capital
   3. Rosette
   4. Abacus
   5. Volutes
   6. Acanthus leaves

C. Shaft

D. Base
   7. Plinth



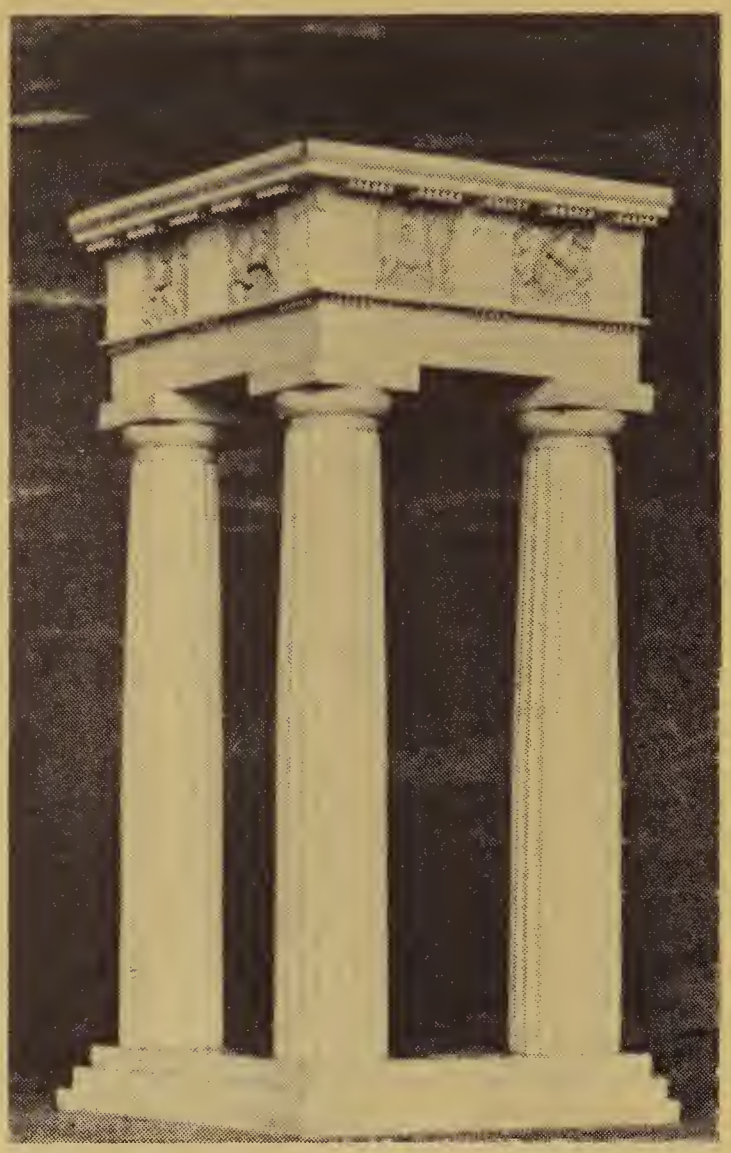
CORINTHIAN ORDER

Last of the three Greek architectural orders to be developed was the Corinthian. It did not come into general use until the middle of the fourth Century B.C., when it is probable that Greek travelers in Egypt brought back ideas for its bell-shaped capital. It is related that Callimachus, a worker in bronze, saw the grave of a young girl, on which a basket covered with acanthus leaves was held down by a tile, and from this group got the idea for the Corinthian capitals, many of which were at first executed in bronze. The volutes and the entablature were Ionic ideas adapted to the style. Though gracefully luxurious in appearance, the lavishly complex capital is broken in silhouette. It never had the popularity in Greece that it enjoyed in Rome.

Tradition in Rome held that a capital brought from a Grecian temple by Sulla was the origin of the Roman Corinthian style, but the Etruscans and early Pompeiians were acquainted with similar forms long before Sulla. The Temple of Mars Ultor (2 B.C.) in Augustus' time, the portico of Octavia, the Pantheon, and the Temple of Castor and Pollux all achieved magnificence in the Corinthian style. A purely Roman contribution to this style was the modillion, that gave the order an entablature of its own. Many departures from the order and variations in it depend on the effects desired and the materials used.

The columns are 10 diameters high, and the base is similar to the Ionic, except for the addition of a moulding, or torus, to balance the extra-ornate capital. The capital is much deeper than the Doric and the Ionian capitals, consisting of an inverted-bell-shaped core carrying a moulded abacus with concave sides and projecting corners. The lower two-thirds of the capital has two rows of acanthus leaves, superimposed one over the other, usually with eight leaves in each row. Between the leaves of the upper row are leafy ornaments known as cauliculi, which are entwined in scroll pattern about the abacus. In the center of the concave abacus is a large rosette. Delicate mouldings add richness to the otherwise Ionic entablature.

ARCHITECTURE



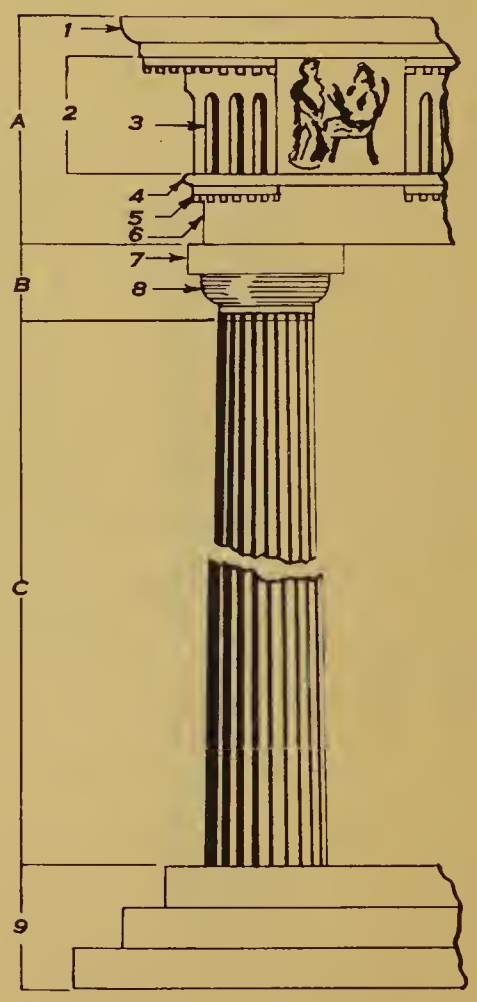
DORIC ORDER

Length 13", Width 13", Height 25½"

A. Entablature
   1. Cornice
   2. Frieze
   3. Triglyphs
   4. Taenia
   5. Guttae
   6. Architrave

B. Capital
   7. Abacus
   8. Echinus

C. Shaft
   9. Stereobate



DORIC ORDER

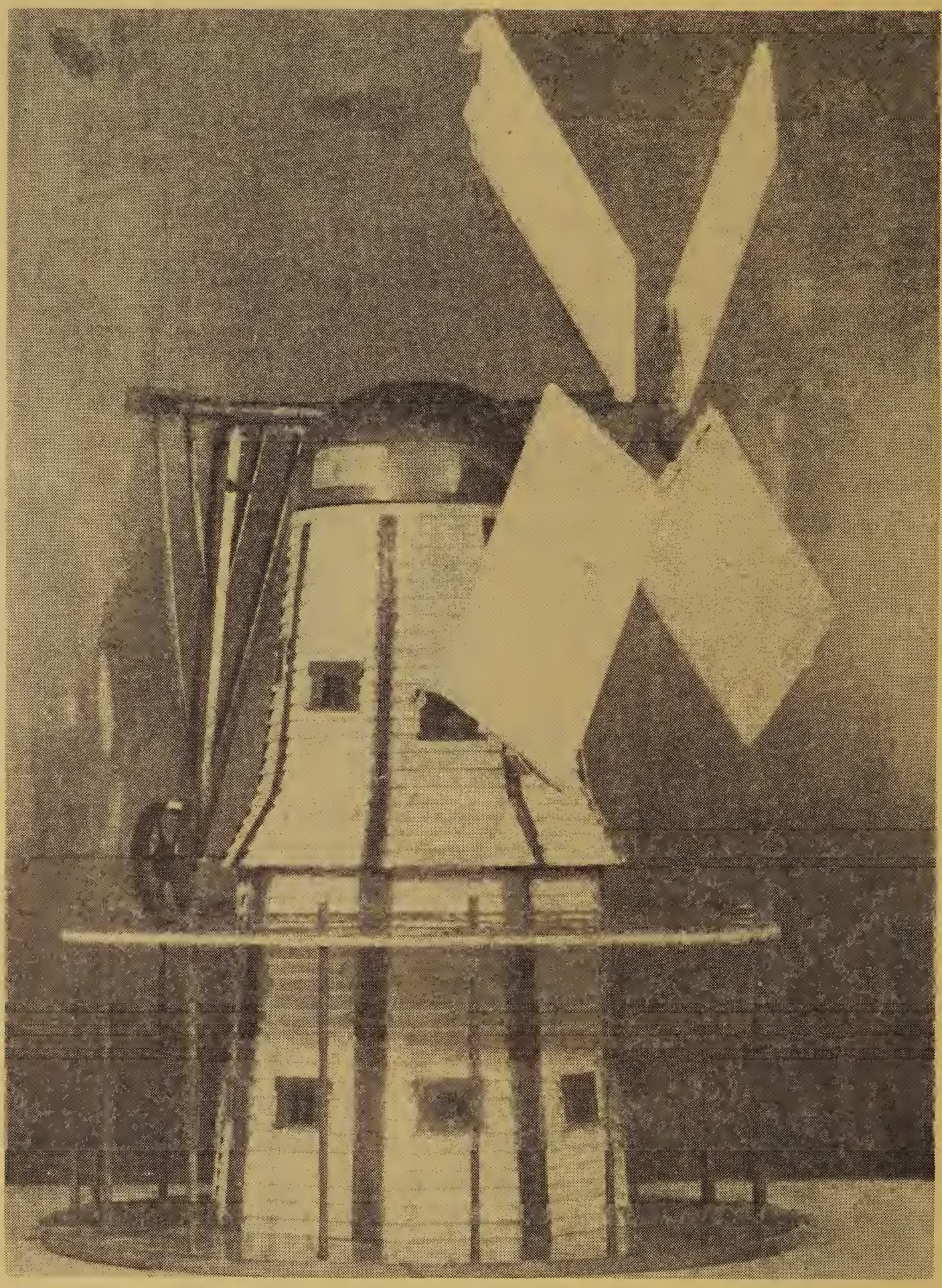
Of the three principal Greek architectural orders, the Doric was not only the earliest to be developed, but also the simplest and sturdiest in form. It relies mainly upon proportion for its best effects of strength and quiet dignity. The style of the columns, which are placed directly on a three-step platform, or stereobate, originated in early rubble and masonry forms having an extreme upward taper and very squat proportions.

Doric capitals were evidently borrowed from Aegean examples, as can be seen in the stair hall of the palace at Knossos (1500 B.C.) and in various wall paintings. The entablature consists of interpretations in stone of traditional Dorian wood construction. The architrave represents the original wooden beam running from post to post, the taenia is a board above this to give perfect bearing to the cross beams, the triglyphs are the ends of the cross beams held in place by pegs through the taenia board that become the guttae in stone design. Boards or decorated terra-cotta plaques, used to close the openings between beams, became metopes.

In later building design, columns were five to six times their diameter in height, and divided vertically with 20 flutes, or shallow, rounded channels. The entablature, which in early work was almost half the height of a column, was reduced in the Parthenon to about one-fifth the column height. So it was that, dating from the seventh century before Christ, a continuous refinement of detail and proportion that we know as "streamlining" gradually evolved in Greek Doric building. Columns became taller and more slender, and the entasis, or curved taper, more and more delicate.

We are gravely in error if we accept the austerity and over-restraint of some ruins as the best in Doric style. As a matter of fact, there was rich and gorgeous coloring in most buildings of the Doric order, though age and weathering have all but obliterated it. Some of the best early Greek Doric buildings were at Corinth (6th Century), Selinus, and Paestum. Roman Doric was a simplified style using the Greek entablature, but its unfluted columns were derived from the Tuscan style of northern Italy. It was used only in smaller Roman buildings.

ARCHITECTURE



WINDMILL

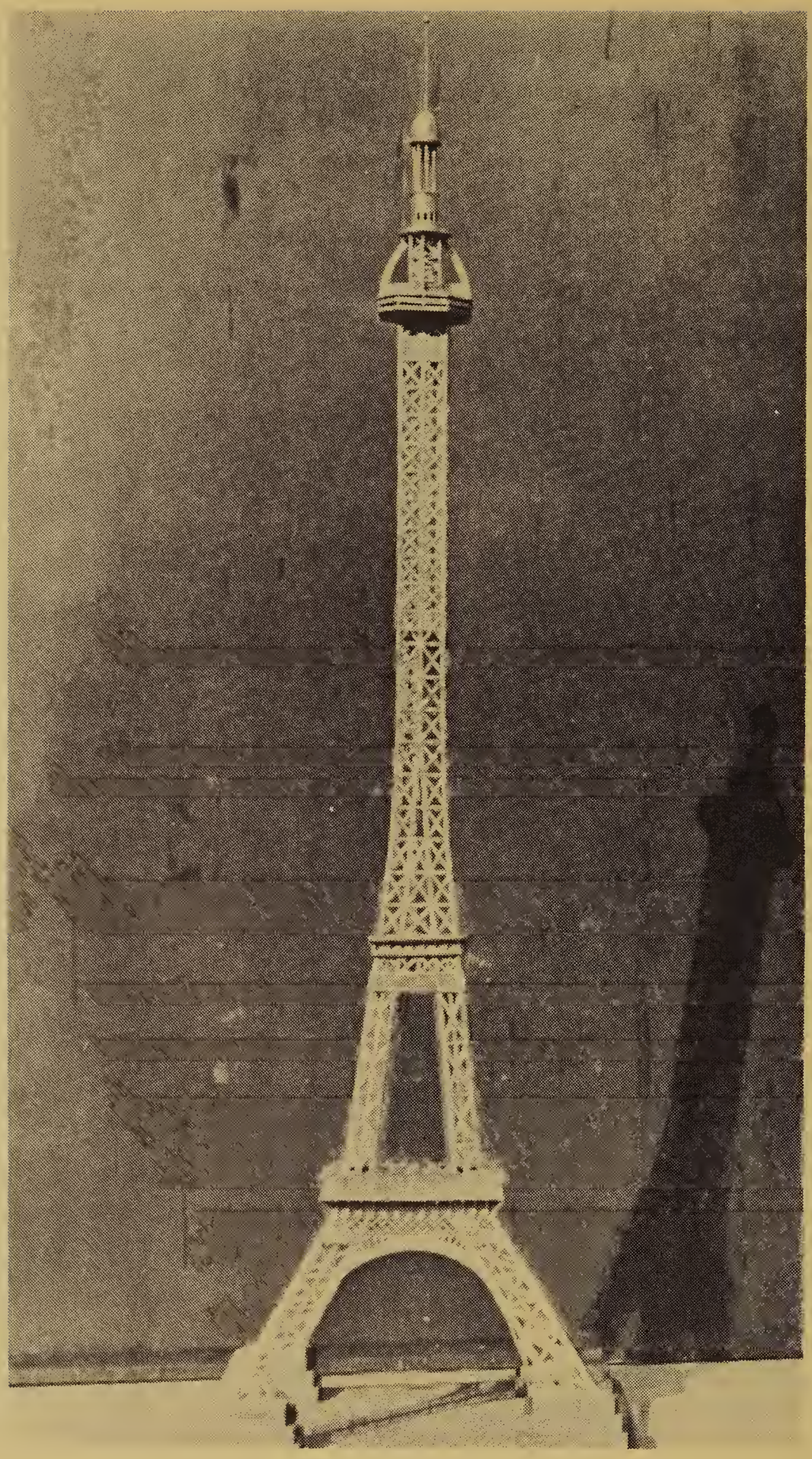
Length 23", Width 23", Height 37"

DUTCH WINDMILL

Although authentic records show that windmills existed in Europe before the twelfth century, they first came into common use in the low countries and in Germany some time later. Early German mills were built so that the whole building revolved upon a central post. In the substantial Dutch-type mill, only the domed roof was set on a track to shift the sails into the wind. Efficient design required the axle to tilt 15 degrees in order to catch the most common angle of the wind; concave or warped sails that would run from within a few feet of the axle to a point nearly touching the ground; and a smooth transmission of power from the large-toothed wheel at the end of the axle to the meshing pinion of the vertical shaft, which took the power down into the room beneath the tower. Here grain was ground or the pumps for draining and irrigating were operated.

The tower was usually hexagonal, with the track and rollers for the rotating bulkhead placed outside on top its walls. Before automatic devices were employed to turn the bulkhead, a man on the cat-walk at the base of the tower pulled the sails into the wind by means of a rope attached to an arm of the roller frame. The canvas sails, usually from four to six feet wide, were stretched over the cross-slats of the propeller-like radial blades. This kind of windmill is in common use today in Holland and the neighboring lowland countries.

The peculiarly American type of steel windmill that was prevalent in rural sections of the United States during the late-nineteenth century was used mainly to pump moderate quantities of water for farm use. At the top of a tapering, skeletal steel tower was placed a relatively small wheel of steel blades, set close together and guided into the wind by a rudder. The adoption of the small gasoline engine and, later, the electric motor and transmitted power has displaced many of these wind-mills. The model shows the type of windmill used by the Dutch.



EIFFEL TOWER

Length 24", Width 24", Height 66"

EIFFEL TOWER

Probably the most familiar structure in the world capital of Paris, France, is the 984-foot Eiffel Tower. This monumental structure has become a symbol of the city, as well known as its boulevards, cafes, and fashionable world of the elite. It was erected as the central identifying feature of the Paris Exposition of 1889, just as the perisphere and trylon were made symbols at the New York World Fair in 1939 and 1940.

The Eiffel Tower is still one of the tallest structures in the world. Only the Chrysler and Empire State buildings in New York exceed it in height, despite its age and pioneer nature. It was an engineering and constructional marvel of its day, and a forerunner of the modern commercial buildings that use metal framework similarly. The tower, 330 feet square at the base, sweeps skyward with a grace belying the 7,300 tons of steel and iron incorporated in it. The highest tapering thrust reaches a height equal to that of a 90-story skyscraper building.

The cost of a million dollars — it would amount to considerably more today — was borne by the French Government to the extent of 30 per cent; the remainder was shouldered by the father of the project, Alexander Gustave Eiffel, who stipulated that he was to be reimbursed for a period of 20 years from admission charges to sightseers. It proved a good investment, for admission receipts in 1889 alone, from persons paying to see "Paris from the sky," amounted to almost the cost of construction.

Although there are stairs, principal access to the upper heights of the tower is gained by elevators. These are of two types. In the lower part of the four, straddling structural legs are two loading elevators, especially designed to ascend the slanting and angled legs to the level where they straighten out. From this point in the actual tower, two elevators, of the straightaway type found in most office buildings, are used to reach the towering upper levels. Replicas of these elevators are found in the actual tower model and in a separate enlarged model of a section of the lower structural leg.

Platforms and galleries at various levels of the tower are occupied by restaurants, physical and biological laboratories, and an experimental station of the French Weather Bureau. The Eiffel Tower has served as a military observation post in the World War and the present war, as a radio broadcasting station, and as a background for huge electrical signs advertising the Citroen, a low-priced French automobile. It is a popular rendezvous for many types of people from many lands, and a romantic place to visit. From the telescopes mounted on its heights can be seen many points of interest in Paris and its environs.

ARCHITECTURE

HOUSE OF THE TRAGIC POET

Length 27", Width 28", Height 17"

HOUSE OF THE TRAGIC POET

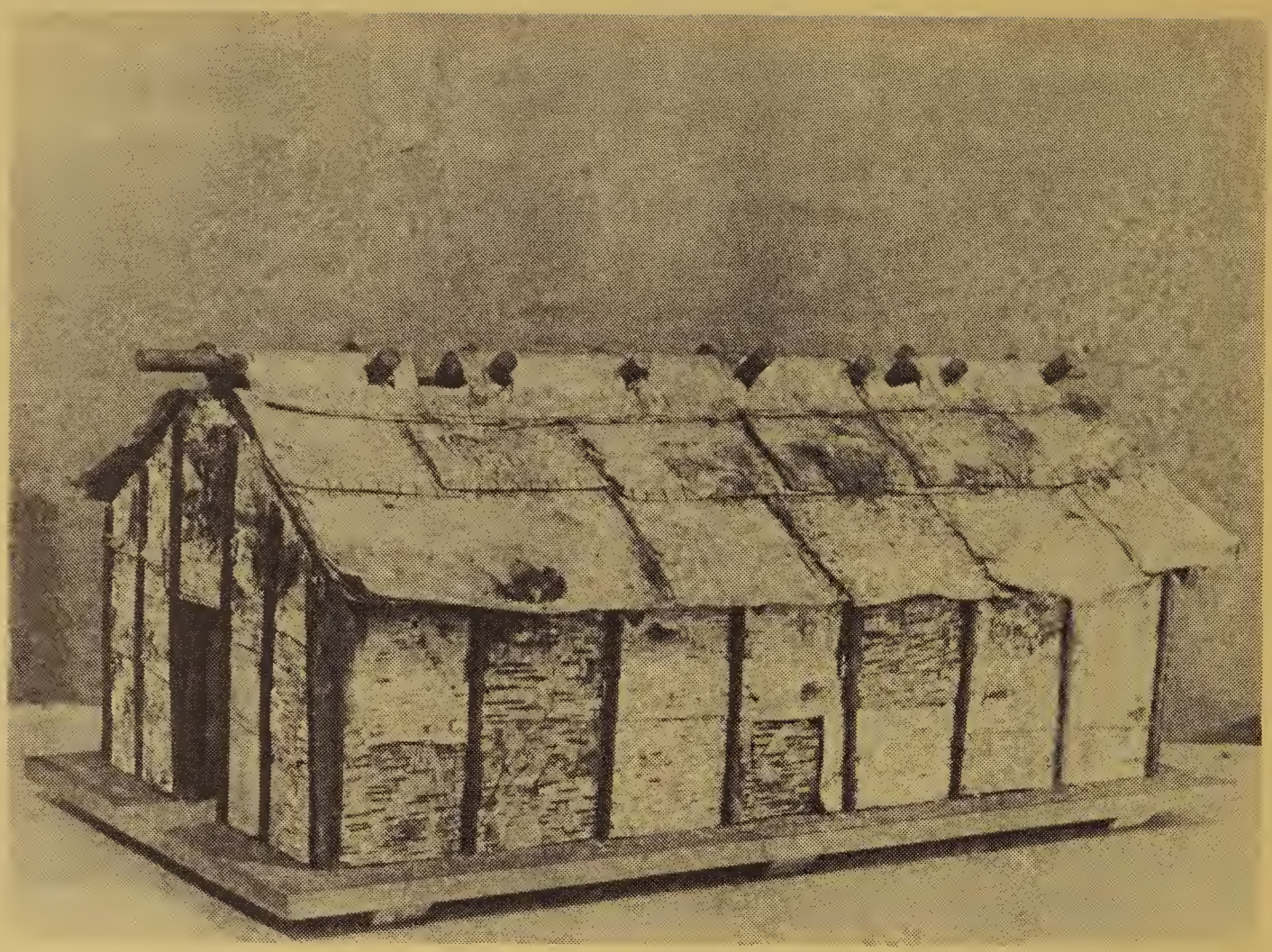
Surprised by the eruption of the long-silent Vesuvius volcano in 79 A.D.,the gay Roman resort city of Pompeii lay embalmed in its blanket of ashes and rock until almost 1800 years later, when it yielded the first of its treasures to excavation parties. Intimate glimpses of the life in the ancient city then came to light. Paintings, tables laden with food, ruts of cartwheels in the narrow, stone-paved streets, and even the expression of pain on the faces of the trapped victims were revealed.

The House of the Tragic Poet was dug from the ashes in 1824. Its name was taken from a painting found on the wall of the record room, or *tablinium,* showing a poet reading from a scroll. In this same room was a mosaic depicting the distribution of masks to a chorus. Just past the entrance door, that swings on pivots placed in sockets imbedded in the marble floor, the visitor is confronted by a large dog about to spring. The animal is black with white spots, wears a red collar, and has inscribed beneath him the words, *CAVE CANEM,* meaning "Beware the dog." He is a pattern in the mosaic floor of the vestibule, a room 30 by 6 feet.

The principal room of the house was called the *atrium.* In the center of the floor was a pool, or *impluvium,* that caught rain falling through an opening in the roof just above it. Paintings in this 28-by-20-foot room include a mutilated panel showing the departure of Chryses, the battle of the Amazons, the fall of Icarus, Venus Anadyomene, the sacrifice of Iphigenia, Leda and Tyndareus, Theseus and Ariadne, Cupid, the parting of Achilles and Briseis, and the marriage of Peleus and Thetis.

At the side of the doorway hangs a nine-foot lance. Several urns in stucco relief occupy wall panels, and to the right of one of these is a painting of Vesuvius before the eruption. Rich reds and golds, black and white, and brilliant yellow shine out from these walls. Beside ornamental screens, there are cupids, dolphins, mermaids, fish, whales, and the hydra in the room's decoration. Over the door appears the gilded image of a spread eagle. Observe the lighting arrangement. Pedestal lamps and the indirect ceiling bowl are not unfamiliar to us.

ARCHITECTURE



INDIAN BARK HOUSE

Length 40", Width 20½", Height 17"

INDIAN BARK HOUSE

Though we usually picture the American Indian as living in a tepee and wearing feathered war bonnets, the facts are that most of the Indians east of the Mississippi river lived in bark houses, or "lodges," and dressed in ceremonial clothes only on special occasions. Among the tribes who lived and dressed in this way were the Iroquois, Shawnee, Wyandotte, Delaware, Seneca, and Chippewa. Bark lodges encouraged communal life not greatly different from that of interior African villages today.

Construction of these Indian bark houses followed the same principles that we use in building modern houses. A framework of stout poles formed the skeleton for the lodge, over which was secured an outer covering of flattened bark sewed on to the frame in horizontal strips by means of bone punches and tough-fibered inner bark. The bark for these houses was usually peeled from elm trees in the spring, cut in sheets four by six or eight feet, and flattened by weights before it was put to use. The completed structure was about 15 feet high at the ridge of the gable, 10 or 12 at the eaves, just over 15 feet wide, and very long—sometimes 100 feet or more. The roof was steadied by rafters every foot or so, and the sides were strengthened by scores of small sapling poles. Log "stringers" were used on top of the roof to anchor the bark.

A row of bunks occupied each side of the lodge. These were built of poles supported by crotched logs about two feet from the floor; and they were about four feet wide. Several layers of bark, covered with soft, hairy pelts, formed beds. Storage platforms were built like a double deck above the two lines of bunks, giving the appearance of a Pullman car to the lodge interior. Strung on poles across the aisle between the storage platforms were chains of corn or fruit to be dried. In the long aisle, or hallway, sat the older people on mats of reeds or husks, while the smaller children played near by. Firepits occupied a prominent place in the aisle, for here most of the cooking was done and light obtained at night. Fires were never permitted to become too large, not only because of the danger, but also because they would otherwise be unsafe to approach for warming and cooking things. Holes in the roof, where the smoke escaped, could be closed with bark panels in case of rain. Doorways were high and wide, and covered with an animal skin, neatly laced to the door post by thongs.

ARCHITECTURE

IONIC ORDER

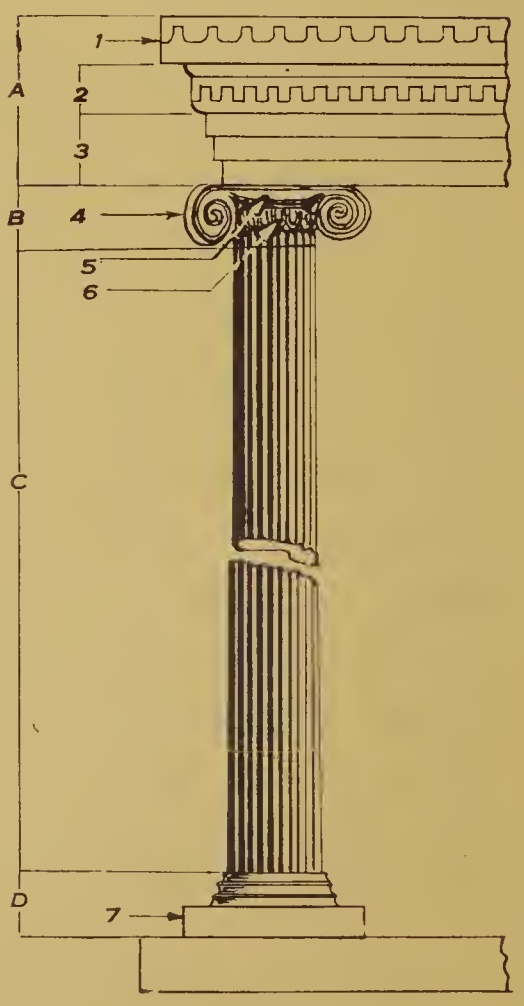
Length 22", Width 22", Height 33"

A. Entablature
   1. Cornice
   2. Frieze
   3. Architrave

B. Capital
   4. Volutes
   5. Abacus
   6. Echinus

C. Shaft

D. Base
   7. Plinth



IONIC ORDER

The popular Ionic order of Greek architecture is an intermediate form between the simple Doric and the ornate Corinthian. An easily identifiable feature is the form of the capital, the flowing, spiraled lines of which resemble the curled-under horns of a ram. The stele capitals of Phoenicia and the lotus capitals of the eastern Mediterranean region were its direct antecedents. Though early Ionic work revealed wide, flaring volutes and awkward proportions, near-perfection was achieved in the Erechtheum (late Fifth Century B.C.) on the Acropolis at Athens. The bold, exquisitely curved volutes, the varied types of base, and the beauty of carved ornament were marks of the Greek Ionic.

The great temples near Miletus and at Priene and Ephesus in Asia Minor were built in a more virile style. Column capitals of this enormously scaled style were smaller than in Athenian buildings, and the dentils of the cornice were large and widely spaced in the manner of separate brackets. Roman Ionic was heavy; it followed the trends in Asia Minor rather than those in Greece.

In the best examples of Greek Ionic architecture, the column, including base, shaft, and capital, was about nine times its lower diameter in height and was either plain or fluted. Flutes were commonly 24 in number, and separated in some instances by narrow, flat members, called fillets, for added richness. The plinth is the square base upon which the column rests. Between the plinth and the column proper appeared round, transitional mouldings of three types — trochilus (concave), torus (convex), and astragalus (small, convex). The architecturally treated wall resting on the columns, called the entablature, is separated into three divisions for identification purposes. Immediately above the columns is the architrave, that comprises three broad, flat bands set one above another, termed fascias. The middle band may be plain or ornamented with sculpture. Treatment of the cornice in the Ionic order includes dentils, protruding blocks in a toothed effect that are refined by mouldings above them. At the corners of a building, the volutes were carried at an angle to give a finished appearance from each side. The volutes, said to have been designed by Ictinus for the Temple of Apollo at Bassae (Phigaleia), project diagonally at the corners.

ARCHITECTURE

KEYSTONE ARCH

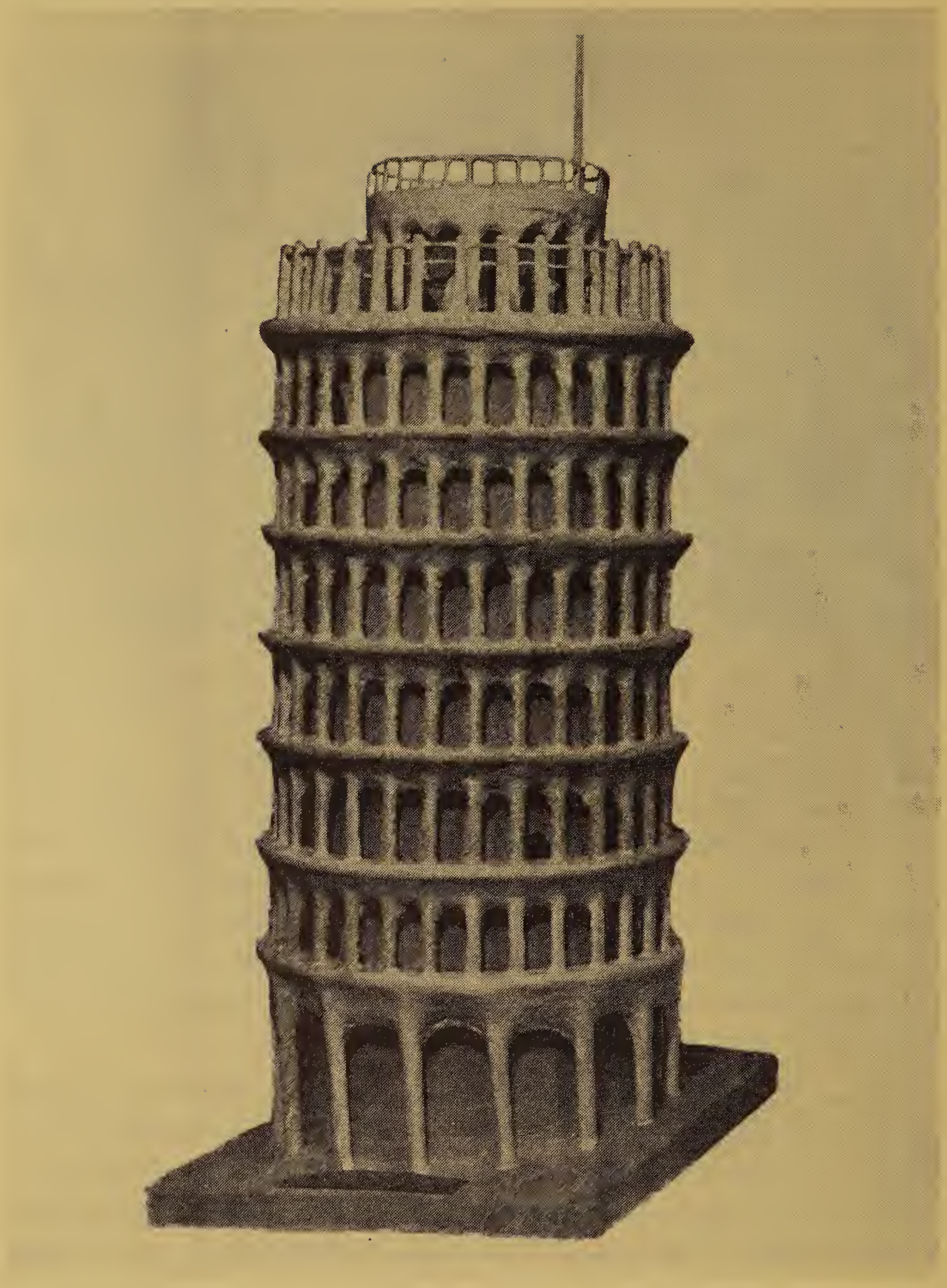
Length 37½", Width 9", Height 17"

KEYSTONE ARCH

Used for everything from tiny windows to gracious colonnades and great dome supports, the keystone arch is simple in principle. To visualize the arch, draw two semi-circles, one larger than the other, from a common base line. Then, from the center of this base line, draw lines running through both arcs. The wedge-shaped segments formed between the arcs represent the stones making up the arch, the top-centermost segment being the keystone. It will be observed that pressure from above is thrown sideways to the stones nearer the bottom of the arch. To counteract this, there must be sufficient buttresses beyond the arch proper at the sides to anchor these stones and absorb the side thrust. Because the compressive strength in this type of arch is important, it follows that a brick arch cannot be expected to carry the same weight as one of granite or marble.

Although the origin of the keystone arch is lost in unrecorded times, the first really successful use of the keystone principle is accredited to the Etruscans, early inhabitants of northern Italy. The Romans appropriated and adapted it for their great buildings and public works. Because of its wide use in Roman buildings, we often call the arch a Roman arch. As the Romans developed architectural skill, rectangular buildings with direct vertical supports gave way to vaulted and domed structures calling into play the lateral thrust. The Arch of Titus and the Pont du Gard Aqueduct are excellent examples of the Roman arch. In the aqueduct, a series of arches countersupporting one another are in turn sustained at each end by piers that are set into earthen embankments. Although it has become somewhat unfashionable, the keystone arch is still well-represented in the public buildings of American cities.

Hook the two buttresses in place on the model, place the two solid arches on Columns A and B and E and F, and set up the cut-out arch on Columns C and D. Place the cusped piece of wood on top of the arches. This represents masonry, a roof, or whatever the arches are to hold up. Put the weight on this piece. The arches remain rigid. As you remove the piece of wood, carefully rest the weight on the segmented arch. If the segments are properly placed and the weight is properly balanced, the arch will hold together. Unfasten the buttresses and the arch collapses, because the lateral thrust is not counterbalanced. Note that buttresses made too short would be useless.



LEANING TOWER OF PISA

Length 12", Width 11½", Height 27½"

LEANING TOWER OF PISA

Fame is often a matter of chance. This is so in the case of the "leaning tower" of Pisa, Italy, that the builders never intended to stand obliquely. Foundations only 10 feet deep and a formation of river mud to build on caused the tower to lean before the third of its eight sections had been completed. Romanesque like the cathedral and baptistry with which it forms a group, the tower was begun in 1174 by Bonanno and finished in 1350.

Galileo, a native of Pisa, used the tower to demonstrate his theory that bodies of different weights fall with the same velocity; he thus gave first impetus to the study of dynamics.

Base walls of the marble cylinder are 13 feet thick, and they are surrounded by the first of the ranges of columns and arches that become open, arcaded galleries in the upper stories. There are 15 columns at the base, 30 columns each for 6 encircling galleries, and 12 columns around the eighth and last story, in which the bells are placed. Because of the weight, the heaviest bell was hung farthest from the leaning side. As it is, when all the bells are ringing, the guard rails quiver and vibrate like a violin string.

A stairway of 194 steps ascends to the observation platform atop the tower and just outside the belfry the smaller diameter of which allows the extra space. A picturesque view of the city and the Mediterranean can be gained from this point. Below, to the north, is the Campo Santo, made by 53 shiploads of earth, brought from Mount Calvary, in the Holy Land.

When measured in 1829, this 179-foot tower had fallen $15\frac{1}{2}$ feet from the perpendicular. In 1910, it was found to be $16\frac{1}{2}$ feet out of line. To insure the safety of the many visitors, the Italian Government in 1928 had liquid cement poured through pipes inserted under the tower. The campanile thus acquired secure foundations for the first time since it was built six centuries ago; it remains to be seen whether twentieth-century skill has saved it from falling to destruction.

LIGHTHOUSE

Length 15½", Width 15", Height 38"

LIGHTHOUSE

The earliest recorded lighthouses were those built by the Libyans and Cushites in Lower Egypt, and tended by priests when a beacon fire was needed for any length of time. So far as we know, the first maintenance of a light solely to guide mariners was in the year 660 B.C. One of the legendary wonders of the ancient world was the Pharos light on an island of that name in the harbor of Alexandria, Egypt. The building stood during the reign of two Ptolemy kings, from 283 to 247 B.C. Its height has been estimated at between four and six hundred feet. Remains of the tower, after it had been destroyed by an earthquake, were still visible in the fourteenth century.

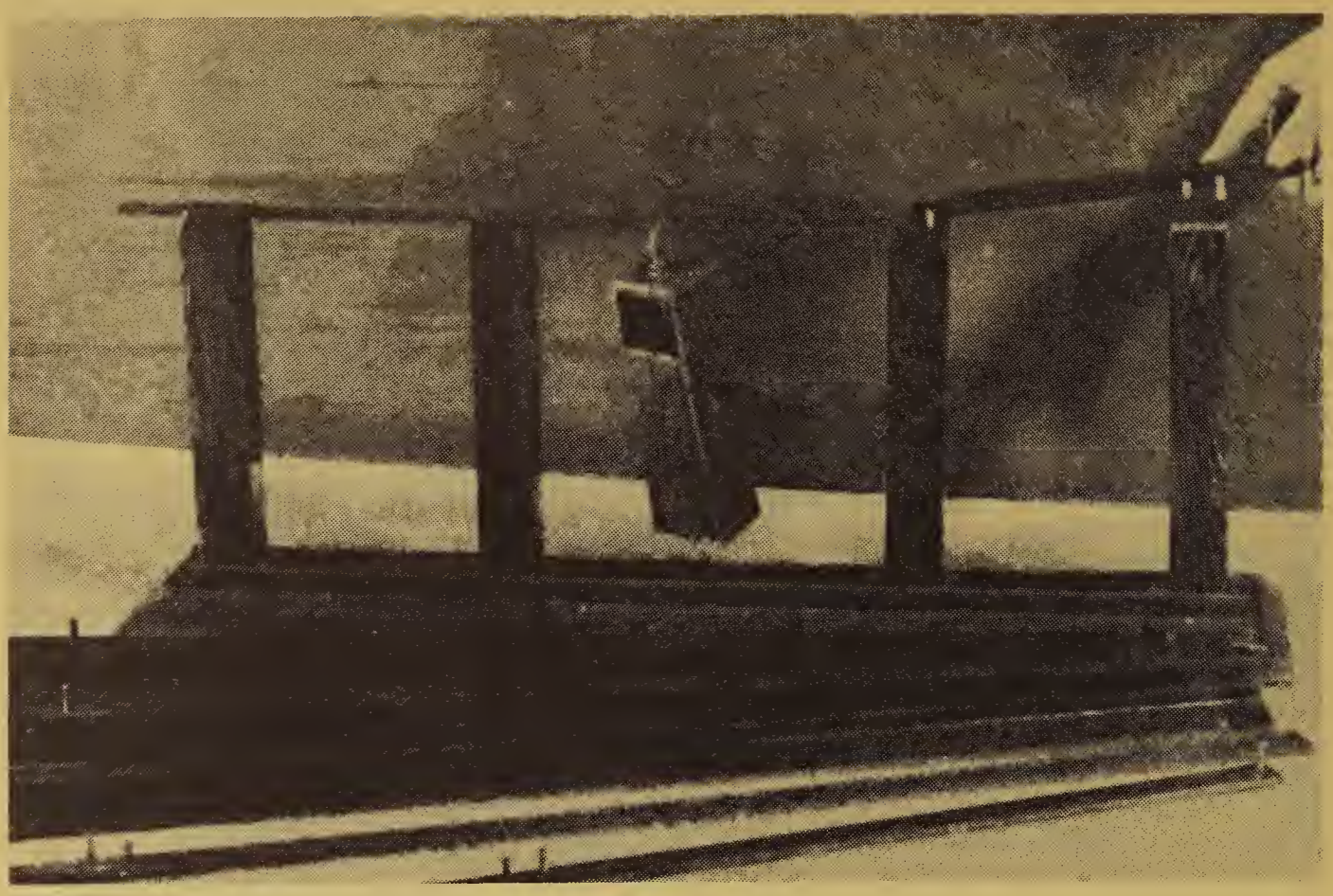
Early lighthouses were all towers of wood or stone on which braziers and grates were kept lighted with wood or coal fires. The use of gas, oil, and electric lamps did not occur until recent times, when systems of refraction, reflection, and revolution were introduced. In addition to the long-range, easily recognized coastal lights, a supplementary use has been made of lightships, fog horns, sirens, flashed lights, colored lights, wireless beams, under-water signals, and buoys until a complete marine language has been evolved for safe travel of the seas.

The oldest lighthouse in the United States is thought to be that on Little Brewster Island in Boston Harbor. The light was established in 1716; the present structure dates from 1859. Other early New England lighthouses were those at Beaver Tail near Newport Harbor (1740), and at Brant near Nantucket Harbor (1754). Previous lookout posts in this section are thought to have been used for military protection rather than for signaling mariners.

Exposed, wave-swept locations on rocks and reefs give the lighthouse keeper a romantic place in the saga of the sea. Such a station is the 89-foot tower of granite on Minot's Ledge (14 miles outside Boston), that is barely out of water at low tide. Its stones are dovetailed and further strengthened by iron bars. After a construction period of five years—the ocean allowed only 30 hours' work one year — this lighthouse was finished in 1860. In building the Dhu Heartach tower, 14 stones, weighing 2 tons apiece, were swept off the already-cemented walls at a height of 37 feet above high water.

Although many lights have been made automatic, the important ones must be constantly watched and tended. Attendants at isolated light-houses are allowed two weeks shore leave for every month-and-a-half of service.

ARCHITECTURE



LINTEL ARCH

Length 9½", Width 36", Height 15½"

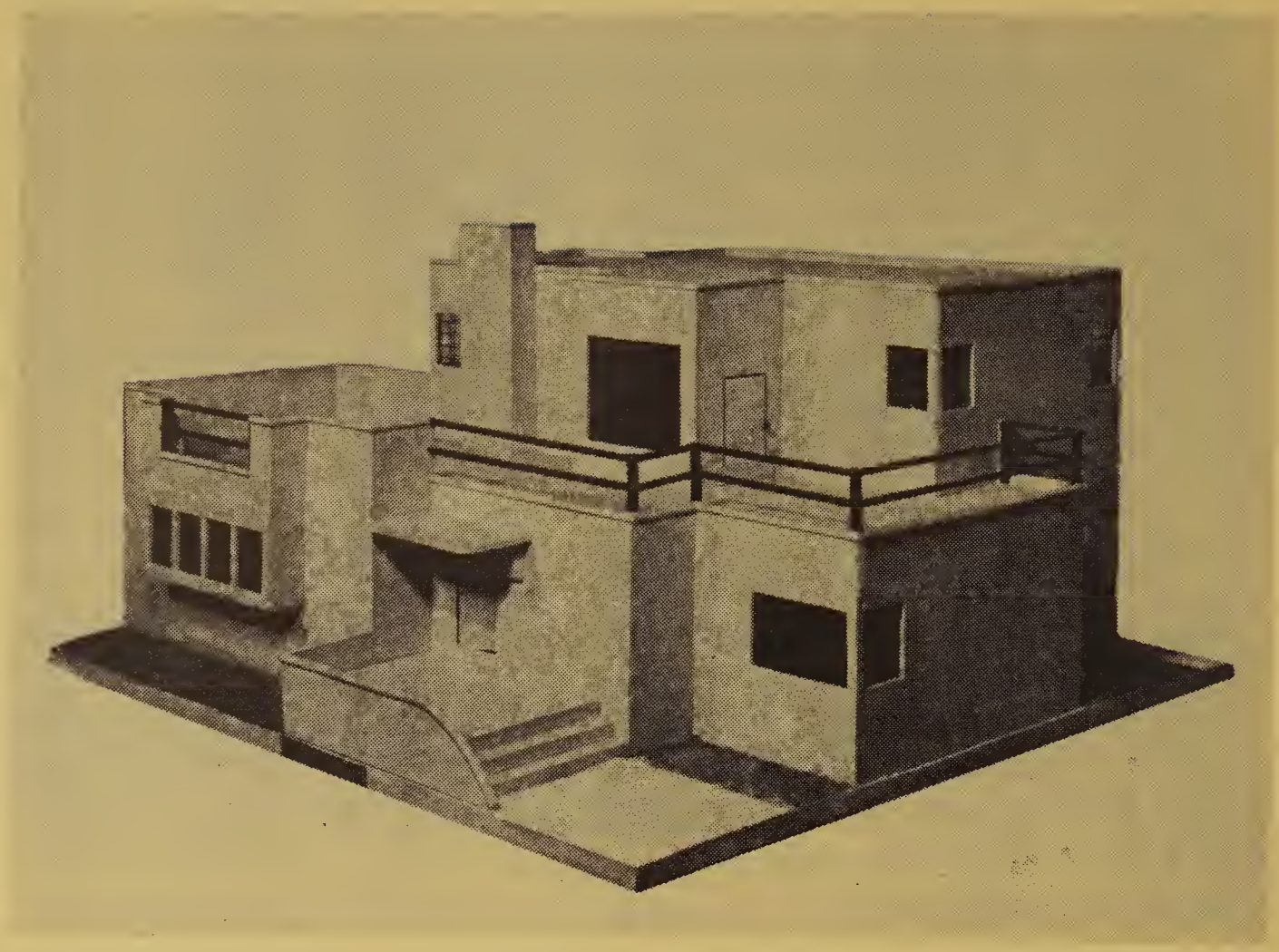
LINTEL ARCH

The simplest kind of opening used in building construction is known as the "lintel arch." It is formed by placing a horizontal piece of stone or timber upon vertical supports at each end. The supports may be masonry walls, as seen in small buildings and homes, or stone slabs and columns of post-and-lintel construction exemplified in the ancient temples and palaces of Egypt and Greece. Since quarried stone cannot be obtained in very great lengths, and the weight of a stone building does not allow huge openings, it can be seen that builders of large structures in early times met difficult problems. The Great Pyramid is a good example of lintel construction. It had to be built almost solid, with narrow openings and inner passages, to avoid collapse. Because of this necessity, ancient buildings (even the Parthenon) were comparatively dark inside.

The science of thrusts and counter forces was not understood until Roman times — and, even then, not too clearly understood. The continuous evolution of engineering principles has given us skyscrapers hundreds of feet high and built of various materials. Our builders no longer depend on the load-bearing limitations of stone, wood, brick and lintel or arch construction alone. The designing of houses, in units, erected of prefabricated materials may eventually displace the age-old methods in home building. The model shows how steel beams and reinforced concrete permit the construction of wide, square openings that become the spacious floors of towering buildings.

Columns A and B and C and D, in the model, are seven inches apart; Columns B and C are eleven inches apart. To illustrate the increase of deflection of the lintel with the increase of the span, set the uniform lintels, 1, 2, and 3, in place, then test the rigidity by suspending the weight from the center. Now remove Column B, and span A and C with Lintel 4. Once again, suspend the weight and test for deflection. Next remove Column C, and span A and D with Lintel 5. When the weight is again suspended, it is seen that the deflection is greater than either that of A and C or A and B. Now fit Lintel 5 into the slots on A and D, again suspend the weight, and notice the great vertical rigidity. This demonstrates how a beam of considerable depth can support a greater vertical load than one of shallow dimensions. Notice the horizontal sway, that steel I-beams eliminate.

ARCHITECTURE



MODERNISTIC HOUSE

Length 34½", Width 34½", Height 18"

MODERNISTIC HOUSE

The story of architecture reveals the fact that many once-popular building styles were discarded and never revived. Perhaps the so-called "modernistic" style will suffer a like fate in time, but the later versions of this style have a freshness and worth that will probably contribute much to future design.

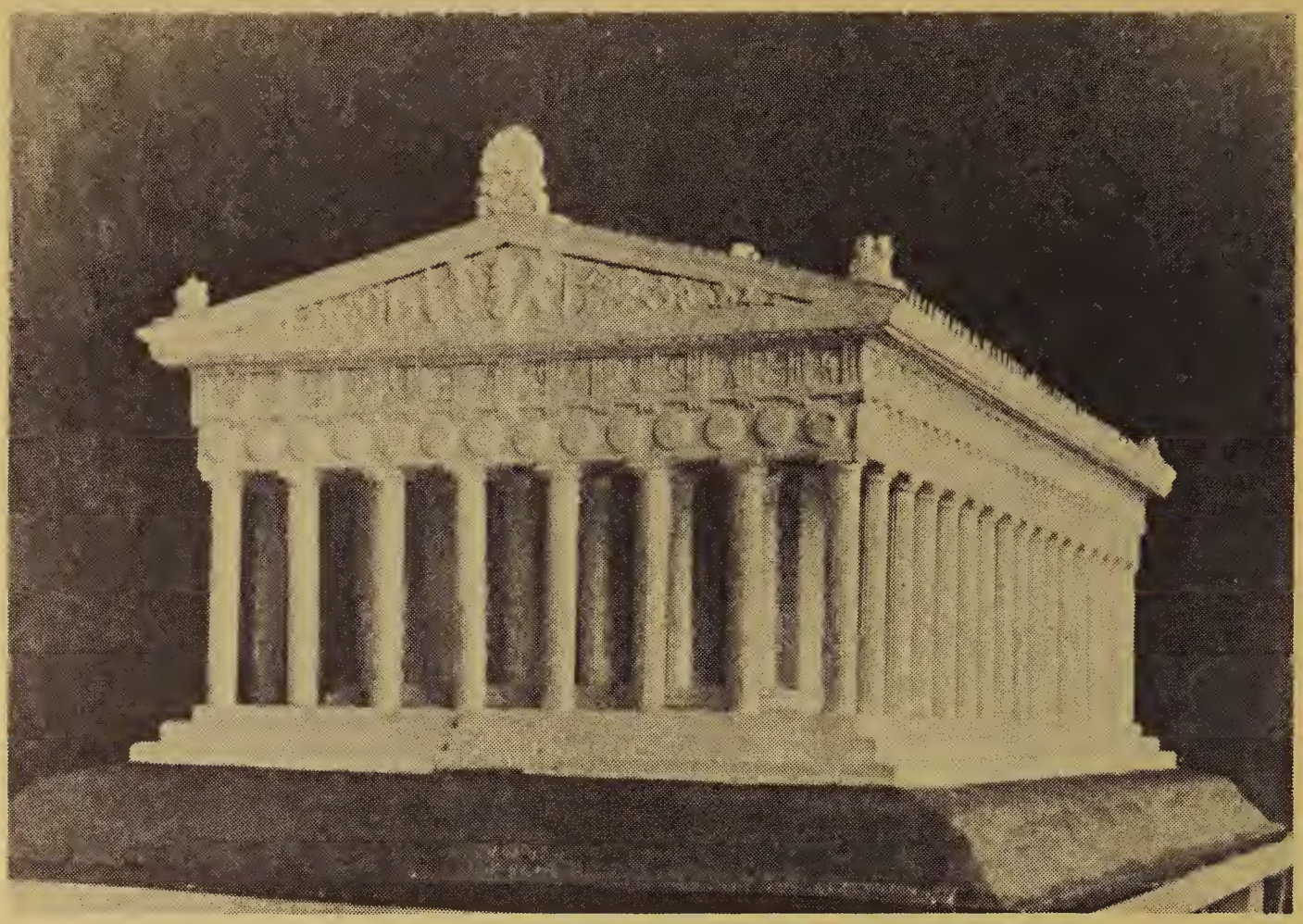
Modernistic architecture is to be found all over the world, from the Scandinavian countries to the South Sea Islands, and in all Europe and the Americas, as well as Africa and Asia. It is as though the whole world were trying to say something in the same idiom.

New materials and methods of construction really led to the modern style, in which functionalism is an important part of the creed. In the best work, the actual lack of ornament is turned into a positive asset. Plain wall surfaces and large masses are contrasted with banks of windows or setbacks, which provide terraces, decks, and porches at various levels. An airy spaciousness is the most sought-after effect, and often unexpected grandeur is attained.

The model is a replica of a modern house situated at 1766 Coventry Road, Upper Arlington, near the northwestern limits of Columbus. Constructed of concrete, including floors and roof, the house is fire-and tornado-proof. Steel-framed corner windows give maximum light and ventilation. Built-in features include a circular leather davenport, a breakfast nook, indirect lighting, electrically operated garage doors, an electric clock, large kitchen storage cabinets, a recreation room, a clothes chute, and shower equipment. (Although these features are not all common in modern houses, they do indicate current building aims.) In addition, there are two bathrooms, three lavatories, and several tiled-floor roof decks for sun bathing. The garage provides space for two cars and has a safety runway.

The simple good taste of straight line and plain surface, and the extremely practical arrangement of functional units, recommend modern architecture as a forthright expression of our contemporary way of life.

ARCHITECTURE



PARTHENON

Length 39", Width 20½", Height 15"

PARTHENON

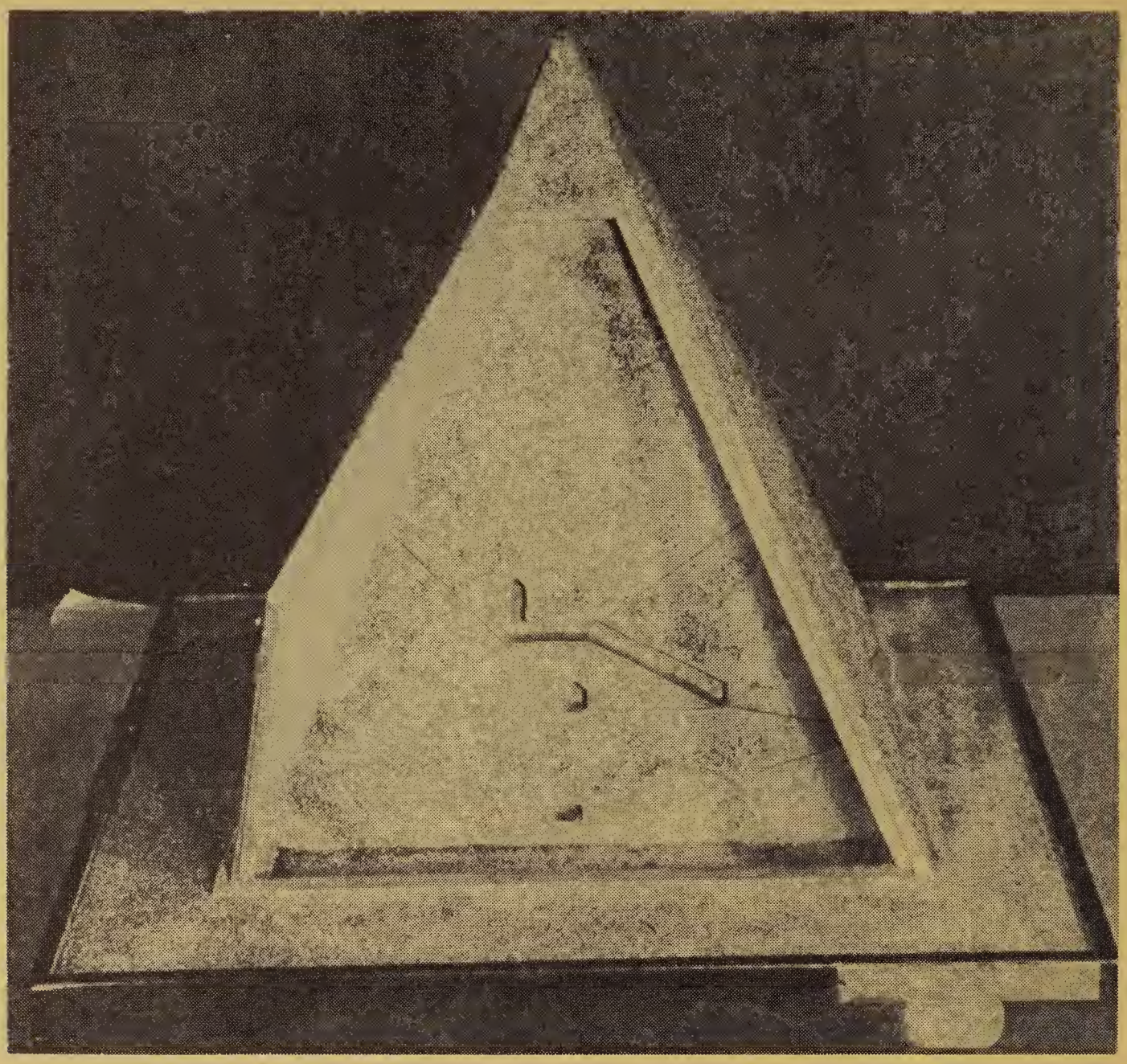
After two centuries-and-a-half, the Parthenon, sitting atop the Acropolis in Athens, Greece, is still one of the wonders of the world. It was built in the fifth century before Christ, during the rule of Pericles. Though the building was planned as early as 457 B.C., actual construction did not begin until 447 B.C. The mammoth gold-and-ivory statue of Athena Parthenos, guardian goddess of the city, was dedicated in 438 B.C.; in 433 B.C., the work of decorating the temple was still in progress.

In the Sixth Century A.D., the Parthenon became a Christian church; in 1458, when Athens was captured by the Turks, the building was made into a Mohammedan mosque, with a minaret for calling the prayer hour; and in 1687, when the Venetians shelled Athens, an explosion of stored munitions wrecked the entire central portion of the temple, killing several hundred people. The remaining foundations, floors, and end colonnades have become a shrine to the beauty and freedom of a vanished civilization.

Because of the mild climate, most Greek political, social and religious ceremonies were held in the open air. The Greek temple was considered the home of the deity, represented by his or her sacred image, and was entered only by the priests. The people stood outside or marched past in festal processions. The frieze of the Parthenon interior depicted the Panathenaea, greatest of all Greek festivals. The richly colored figures of the procession were shown approaching a group of gods sculptured in the center of the east wall.

In designing the temple, Ictinus and Callicrates employed the Doric order, which had dignity and imposing grandeur. Phidias, greatest of Greek sculptors, supervised construction, and saw to it that each slab of the white Pentellic marble was laid properly. Proportions are ideal. The building is 228 feet long and 101 feet wide (a ratio of 9 to 4), and stands 80 feet high. In beauty and grace of design, the Parthenon is unexcelled. So cunningly conceived were the lines of the Parthenon that even the deficiencies of human eyesight were considered. The slight curve, or entasis, of the Doric columns gives an appearance of vertical perfection, and a subtle curvature of all horizontal lines compensates for any illusion of concavity.

Sculptured groups of the pediments, the triangular spaces under the roof gables at each end, depicted the birth of Athena on the east front, and the contest between Athena and Poseidon for the land of Attica on the west front. Sculptured metopes of the exterior frieze, an ornamented band just under the cornice, represented the battles between Gods and Giants, Greeks and Amazons, Greeks and Centaurs, and one other subject, obliterated by time. These stories pictured in the stone of the temple appeared on the east, south, and north sides respectively, and were an inherent part of the building design with regard to scale, relief, and play of light and shadow.



PYRAMID INTERIOR

PYRAMIDS

Length 23", Width 25", Height 4"

PYRAMIDS

The tombs of Middle Egypt after 3000 B.C. show the most successful use of true pyramidal form in the history of architecture. Forerunners of the Egyptian pyramids were the stepped Assyrian ziggurats (superimposed, receding terraces of earth held in place by masonry walls) and prehistoric Egyptian tombs.

Early tombs were square chambers sunk into the ground and roofed with poles and brushwood covered with layers of sand. Later, a wooden chamber with beam roof and stairway was built in the pit. Mastaba tombs were such chambers covered with an earthen mound held in place by masonry walls. Next, the whole oblong structure, with stairs and underground chamber, was made of solid brickwork. Finally, stone replaced the brick and a slant was given the outside walls. Enlarged by repeated heightening and successive coats of masonry, this tomb then took the form of a stepped pyramid. At Medum, the stepped outside slopes were filled in and a smooth casing of stone was added from base to top, thus giving the world its first real architectural pyramid.

The Khufu pyramid at Gizeh, called the Great Pyramid, has a more elaborate interior arrangement of rooms than any other. The model presents a cross-section of this pyramid. Some 47 feet above ground level, the entrance opens into a passage sloping steeply to an unfinished underground chamber. Sealed in the roof of this passage was discovered the opening of an upward-slanting passage leading to the burial rooms in the heart of the pyramid. Where this passage widens into the grand gallery approaching the king's chamber, there was found in the floor another sealed opening, which disclosed a passage leading to the queen's chamber under the king's room. It is said that a sarcophagus once rested here — probably that of Khufu's co-regent. Following the grand gallery in its ascent, one comes to the king's chamber at the far end. This room is narrow and high, having a roof of heavy stone slabs sloping gablewise, like rock formations in early Egyptian cave temples. Stones at the ridge are held apart to provide a margin of safety should the pyramid settle from earthquake shocks. The upward-sloping ventilator shafts at this level provided air for priests making offerings and allowed entrance to deities attending the dead. Furthermore, according to one authority, "the rays of Sirius, the dog star, whose heliacal rising announced the beginning of the Egyptian year and the flooding of the sacred river which brought prosperity to Egypt, were at right angles and shone straight down the ventilating shaft into the royal chamber illuminating the head of the dead Pharaoh as the star crossed the meridian." The remains of the pharaoh, Khufu, bound in bituminous mummy cloth, lay in a sycamore coffin placed inside three granite sarcophagi. Height of the Great Pyramid is 484 feet — about that of a good-sized modern skyscraper.

ARCHITECTURE

SALISBURY CATHEDRAL

Length 36", Width 41", Height 36"

SALISBURY CATHEDRAL

The Cathedral Church of St. Mary, better known as Salisbury Cathedral, is a fine example of Early English Gothic architecture. With the exception of its spire and a few minor parts, it was begun and finished in 1220 - 1266 A. D. Because of this brief building time, the cathedral presents a uniformity of style rare in large buildings of those days.

Salisbury Cathedral is one of the oldest church structures in Europe. According to legend, Bishop Richard Poore selected the site after he had been counseled to do so in a vision of the Virgin. It is thought that Elias de Durham, canon of the cathedral, was the principal architect. An unfortunate restoration in 1782 to 1791 destroyed many magnificent stained-glass windows that had escaped the Reformation, and removed two perpendicular Gothic chapels and the detached belfry that stood to the northwest of the church building.

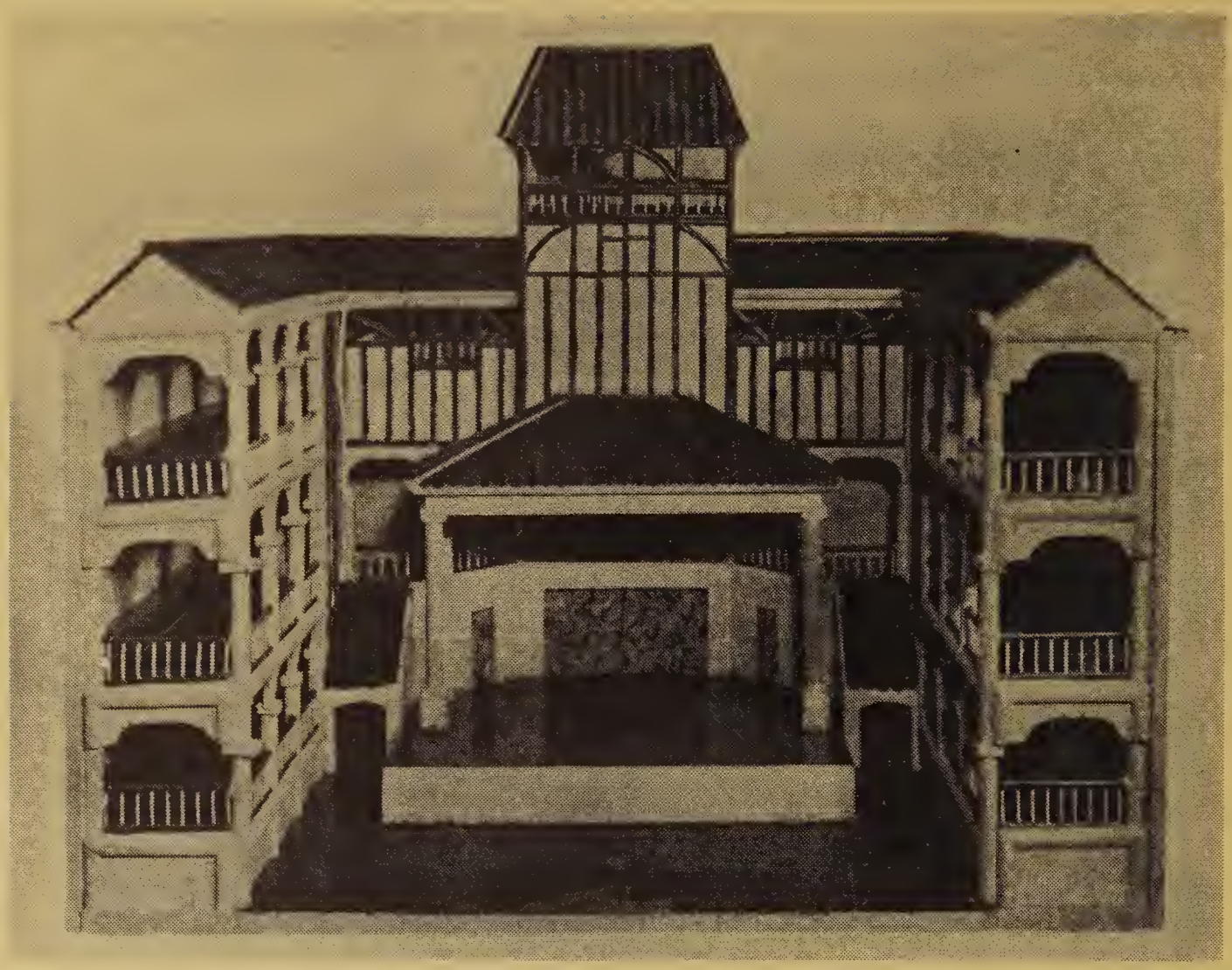
The cathedral proper consists of a nave of 10 bays, with aisles and a lofty north porch, transepts, choir, lesser transepts, presbytery, and lady chapel. The building is 473 feet long. The nave is 229 feet long, the choir 151 feet, and the lady chapel 68 feet. Width of the nave is 82 feet, and height 84 feet. The spire, which reaches 404 feet, is the highest in England. Frequent use of Purbeck marble for shafts contrasts well with the delicate gray of the freestone, the chief material used.

The lady chapel is the earliest portion of the original building, the west front came later, and the two upper stories of the tower and the spire above were the latest, as is shown in their use of early decorated Gothic. Rich ornamentation of the west front indicates a transition to the decorated Gothic style. English Gothic is much plainer than French Gothic, with its intricate and delicate tracery.

Some time after 1250, small chapels or shrines were built up over tombs; they were an elaboration of the wooden and stone effigy tombs of earlier periods.

The splendid octagonal chapter house, dating from the time of Edward I, has a series of sculptures of that period. In the cathedral library, there are many valuable old manuscripts and books. The cloisters, directly south of the church building, were built soon after the completion of the main structure. They are used for social and athletic activities of the church body.

ARCHITECTURE



SHAKESPEAREAN THEATER

Length 24", Width 36", Height 30½"

SHAKESPEAREAN THEATER

During the Middle Ages, and for some years after the Renaissance came in Europe, the drama in England was almost entirely in the hands of traveling church players and strolling minstrels. It was not until the latter half of the sixteenth century that permanent buildings were erected solely for the temporal drama.

The plan of these theaters was familiar to those who frequented the earlier inn courtyards, for here were the galleries, reaching to the top of the walls, and the stage platform in the pit floor, where stood the poorer classes, eating lunches, calling out their desires, and thoroughly enjoying the performance or gossiping about and ogling the moneyed people in the galleries above. At times, chairs were placed on the stage for titled guests or for overflow crowds.

Every available foot of space was used in such theaters as the Globe, the Fortune, and the Swan. Besides the galleries on three walls, a fourth was sometimes placed above the "green-room" entrance behind the stage. (The "green room" was the chamber in which the actors awaited their cues.) Specifications for building the Fortune Theater provided that "heavy scantlings" be the timber used; the walls were to be of wood and plaster, the roof of tile, the roof gutters of lead, and the stage of oak; and the "green room" was to have glazed windows. Boxes were called "gentleman's rooms" and "two pennie rooms."

The model is patterned after the ingenious reconstruction drawn by W. H. Godfrey in 1907, who followed the specifications for the Fortune Theater. The plan was similar to that of many other theaters of Shakespearean times.

SKYSCRAPER

Length 13", Width 13½", Height 38"

SKYSCRAPER

Typical of the great steel-framed skyscrapers made possible by commerce in the United States is the 44-story Chicago Board of Trade Building. At its highest point, 612 feet above the street, is a statue of Ceres, the Roman goddess of grain and the harvest. The building is a symbol of Chicago's position as the world's foremost speculative grain market. Within it, the Chicago Board of Trade provides facilities for all kinds of commodity trading, notably in grains such as wheat. Representatives of world-wide grain interests, millers, processors, importers, exporters, and occasionally Government officials meet here to buy and sell wheat or other commodities.

The Chicago Board of Trade was organized in 1848 as a nonprofit organization. In 1935, its 1,549 members represented interests in every civilized country. The exchange operates with a strict code of rules under the supervision of the United States Government. Benefits of this organization are establishment of a common market place for commodities traded in; provision of a constant market for farm products in any amount; distribution of price quotations by press, telephone, and radio; maintenance of uniform weights and measures; dissemination of world-wide crop news and information; and price insurance through marketing in futures. (A future contract is an agreement to buy or sell a specified amount of grain at a certain price on some set future date. Such transactions involve hundreds of millions of bushels of wheat at the Chicago wheat pit.)

The description of trading in wheat found in Frank Norris' novel, *The Pit,* is still applicable today. Of course, there have been some changes. Instead of the clicking of telegraph instruments, which Norris described as an "incessant staccato stridulation," the more reserved tones of teletype machines now lend their voices to the hum of the trading floor. Messenger boys still hurry about, much as hotel page boys do, calling out and searching for clerks and traders; but these, too, have partly been supplanted by the increased use of the telephone and the new public address system.

For the most part, however, "trading on the floor" is the same today as it was in 1900. As at the turn of the century, "throngs of traders" gather at the pits (the quotation-announcement desks), waiting for further tidings of the rise and fall of grain and commodity prices over the world, each new quotation bringing joy or chagrin to the individual traders, brokers, and scalpers. And there is still the "deep toned hum of the murmur of many voices swelled like the riding of a tide."

GREAT SPHINX OF GIZA

Courtesy Ralph Fanning

SPHINX

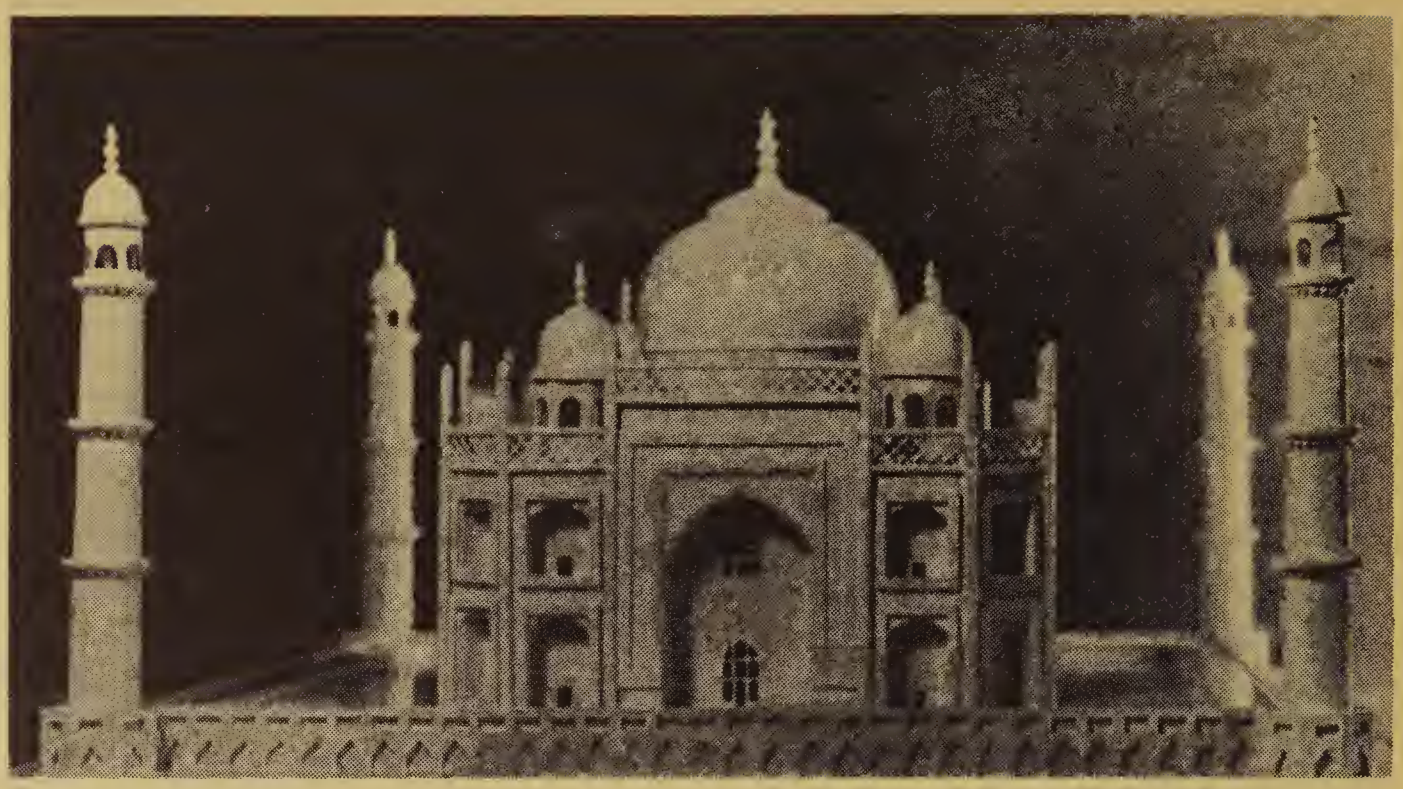
The legends and purpose of the sphinx as a symbol have been lost. The more we know of it, the more of a riddle it becomes. Its origin probably lies in the time before the known civilizations flourished; it was already a well-established form in ancient Assyria. The word *sphinx* is Greek for a creature with a human head and a lion's body. Assyrian sphinxes were of both sexes. The male had a curled beard; the female, wings. Persians cut sphinxes into jewel stones, but used them in no other way. The Romans added an asp to the forehead of their sphinxes.

The Egyptians evolved a peculiar type of sphinx, which was male, wingless, and recumbent, and had straight hair. It is possible that the features resembled those of the reigning king, who thus took unto himself godly attributes and strengthened his claim to divine ancestry. The Great Sphinx at Gizeh is the most famous of this type. It is 189 feet long and 65 feet high, and was carved from a natural hillock of rock, probably in the Fourth Dynasty. Recent excavations have uncovered the front paws, which are of brick and built onto the body. A modern painting shows, between these majestic paws, a modern Mary and her son Jesus asleep (during their flight into Egypt) as Joseph dozes, while watching, beside the campfire near by. The Sphinx seems to be guarding them.

In the ancient world, treasures, palaces, and temples were guarded by sphinxes. Singly, in pairs, and in rows, to form an avenue of approach, stood these stony sentinels. Some think of the Great Sphinx as a guardian of the Nile valley. The Egyptian word for sphinx meant "watchman" — a comforting, tireless protector in a strange and terrifying world. According to inscriptions of a later date in the shrine between the paws, the Sphinx was Harmachis, the sun god, facing east. It may have become associated with the idea of the sun dispelling darkness and of life overcoming death.

Sphinxes have been found carved in ivory, bone, and precious stones, and on plates of glass and gold; one even perched on the helmet of the Athena statue in the Parthenon. Most famous of the Greek legendary sphinxes was the female one at Thebes. "What is it that is four-footed, three-footed, and two-footed?" Thus would she question Thebans, and, if they failed to answer correctly, she would snatch them away and devour them in her mountain retreat. One day, Oedipus answered that it was a man who crawls as a child, walks erect as a man, and uses a cane in old age. Immediately, the sphinx threw herself down the mountain and was seen no more. This myth partly explains the belief we have inherited that the sphinx holds the key to man's destiny.

ARCHITECTURE



TAJ MAHAL

Length 39", Width 39", Height 21½"

TAJ MAHAL

The most costly mausoleum, and one of the most beautiful buildings, in the world is the Taj Mahal at Agra, one-time capital of India. It was built by Shah Jahan for his empress and most beloved wife, Mumtaz-i-Mahal, who died in 1631 A. D. She was also called Taj Mahal, "crown of the palace."

Many skilled artists and craftsmen were brought from foreign countries to work under Usted Isa, the architect, in order that the building might approach perfection. Work was stopped on all temple building to facilitate progress on the fifteen-million-dollar Mogul-style edifice; nevertheless, it took 20 years to build this monument to princely sorrow.

The building is set in an exquisite walled garden, with a gate and mosque as tributary features. A vast marble terrace, 313 feet square, holds the structure, which is crowned by a great central dome and four smaller domes at the corners. Four minarets, or prayer towers, rise from the terrace corners. The main part of the building is 186 feet square; the dome is 58 feet in diameter, and reaches a height of 210 feet; and the minarets are 133 feet high. Subordinate to the outline is the richly conceived ornamentation. All spandrels, angles, and important spaces are enhanced with a patterned inlay of semi-precious stones. Bloodstone, agate, jasper, and similar stones are set into wreaths, scrolls, and fretwork sculpted in the marble to form the most precious style of ornament ever devised. Passages from the *Koran* alternate with symbolic designs to decorate the exterior of the mausoleum.

It is said that the Taj Mahal needs no unusual cast or tint of light to reveal its true beauty. Filtered through alabaster and semi-transparent marble, the light of the interior is such "that was never yet on land or sea." In this poetic setting lie the remains of Shah Jahan and Mumtaz-i-Mahal, side by side, below two cenotaphs seen beyond a delicate alabaster screen. Adding to the ethereal atmosphere of the buildings is the approach through a dignified formal walk, beside the reflecting pool and fountains and along avenues of cypress trees.

AMERICAN HISTORIC HOUSES

LINCOLN LOG CABIN

Length 24", Width 31", Height 27½"

LINCOLN LOG CABIN

Just as modernistic houses indicate the tempo of present-day life, so the log-cabin homes of America's pioneers intimated the life ot their day. Hewn by hand from the forest trees, the logs were often laid into place at a "cabin raisin'," to which all the neighbors from miles around came for hard work and robust fun. Originators of the log structures that served so well in the interior country are said to have been the Swedes of Delaware.

Use was made of every square foot of space in the cabin. The one room in many log homes served as eating, sleeping, and working quarters for several persons. A ladder to the second-story shelf under the sloping gable roof gave access to storage room, added sleeping quarters, and provided a place of last defense. On a frontier farm, such as the Lincolns had settled, it was often necessary to use the cabin as a refuge from marauding Indians or prowling wild animals; for, at that time, though their power in this section had been broken, there remnants of Indian tribes still wandered about.

Usually the cabins were simple rectangles in form. The walls were made of tiers of logs notched at the ends to fit over one another at the corners of the house. Cracks between the logs were filled with hard-packed clay, and windows made of greased, heavy paper. The roof of shingles was held in place by poles. A steep pitch was necessary to give the roof resistance to heavy snow-, wind-, and rain-storms. A large fire-place, built of stones, served for heating and cooking purposes. If stone was scarce, the chimney was made of small logs and sticks, lined with hardened clay.

Although the old log cabins were crude, they doubtless made good homes. The soft, quiet light filtering through the paper window, the smell of the earth floor, the snugness of a roaring fire on a cold night, the homeliness of gingham, rough logs, and pewter must have created a cozy atmosphere.

The model is a replica of the Kentucky cabin in which Abraham Lincoln was born, February 12, 1809. Exact detail is followed, even to the number of logs used. The fireplace, chimney, and furniture are all in keeping with the first home of "Honest Abe."

AMERICAN HISTORIC HOUSES

MONTICELLO

Length 36", Width 41", Height 16½"

MONTICELLO

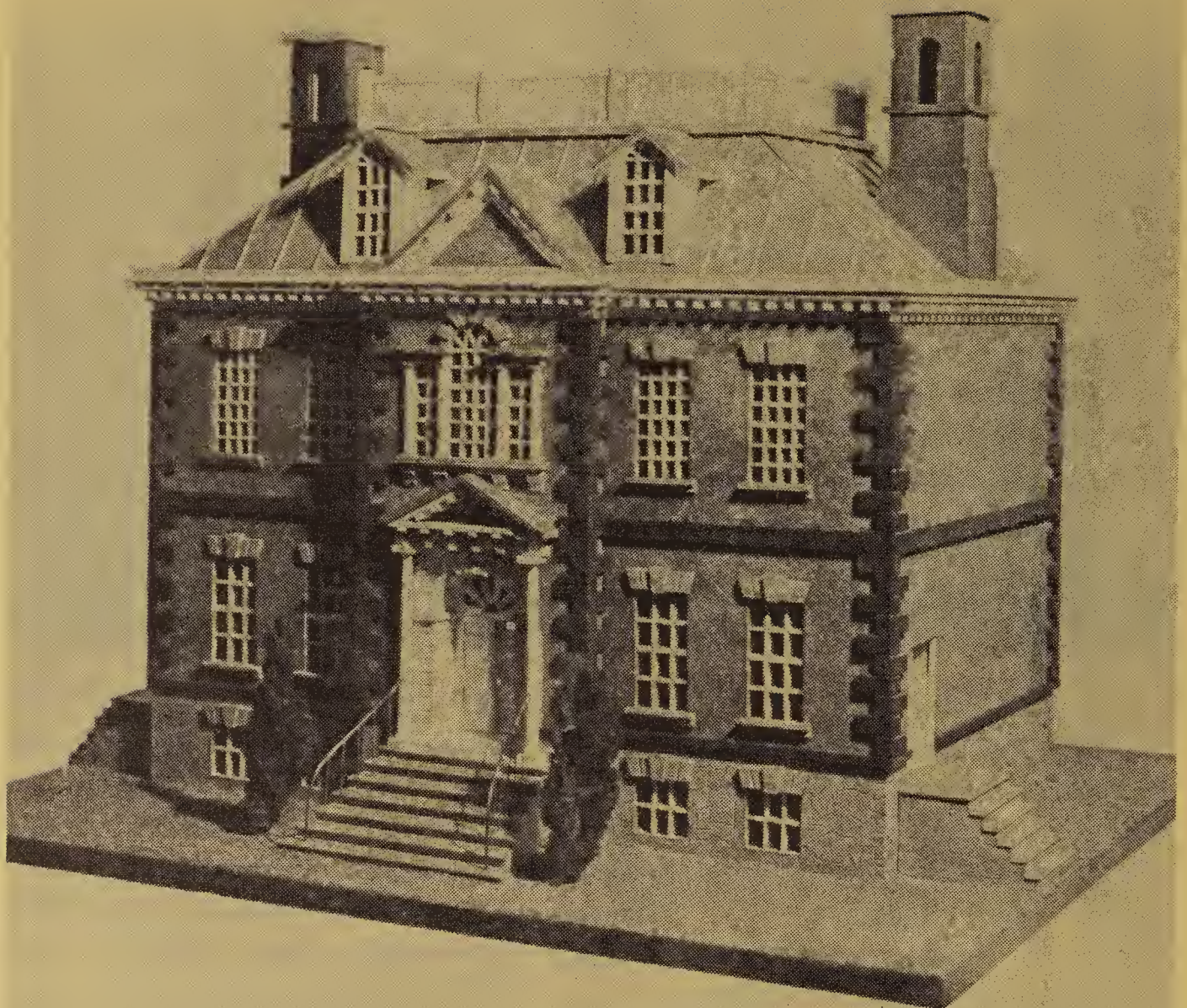
Monticello, the home of Thomas Jefferson, third President of the United States, stands on top of a "little mountain," 600 feet high. Jefferson was born in 1743 in a little place near by, called Shadwell. The site of Monticello had been in the family since 1735, and as a youth the future President selected it for his home. He built his mansion continually through the years of his public life.

Like Washington and other leading men of the time, Jefferson was actively interested in architecture. He not only designed lasting public works, such as the halls of the University of Virginia, but also secured uncommonly good results at Monticello, with only slave labor to execute his designs for the mansion and grounds. Bridle paths were laid through the forest, and rare trees and exotic shrubs transplanted from all parts of the world. For 30 years, the development of Monticello, the creation of one man's genius, continued: bricks were made, nails wrought, laborers trained, vehicles constructed, and orchards and fields planted and cultivated.

Besides being eminently successful in politics, philosophy, and letters, and the prime mover in the drafting of the Declaration of Independence and the effecting of the Louisiana Purchase, Jefferson was clever at inventing gadgets for his own convenience and comfort. He built a device that lifted his bed to the ceiling of its alcove, allowing a passage underneath. He installed a clock that could be read outside or inside the house; the ladder reaching to the clock folded neatly into a slender, solid piece of mahogany. A weather vane on the roof of this same portico was connected to a dial and indicator inside, eliminating the necessity of going outdoors to know the wind direction. On each side of the fireplace in the great dining room, he installed dumb-waiters, one to bring food and carry away soiled dishes, the other to empty ashes and convey firewood to and from the basement story. Revolving tables, portable tables, and collapsible tables were built by this man of world affairs when he turned to other tasks for relaxation. Southeast of the mansion, there was a bachelor hall, where he repaired to rest and be free from care. This became the "honeymoon cottage" for his only marriage.

The gracious hospitality extended to endless cordons of guests at Monticello reduced Jefferson's private fortune to such an extent that he had to part with some of his estate, including his prized library, and, after he had been 60 years in public life, even a public subscription did not prevent Jefferson from dying a poor man.

AMERICAN HISTORIC HOUSES



MT. PLEASANT

Length 29½", Width 34½", Height 26"

MOUNT PLEASANT

One of the finest examples of domestic Colonial architecture is the house called Mount Pleasant, high above the Schuylkill River in Fairmount Park, Philadelphia. The mansion has an interesting history. It was built in 1761 by John MacPherson, a former sea captain and privateer. In 1779, MacPherson sold the property to Benedict Arnold for $18,000. Major General Baron von Steuben, called the "drill master of the Revolutionary army," lived at Mount Pleasant for several years. Edward Shippen, Chief justice of Pennsylvania, whose lovely daughter, Peggy, married Arnold, sold the house in 1792 to General Jonathan Williams, who lived here until his death in 1815. In 1868, the mansion became the property of the city, and now, refurnished in the style of its period by the Pennsylvania Museum of Art, is a public museum.

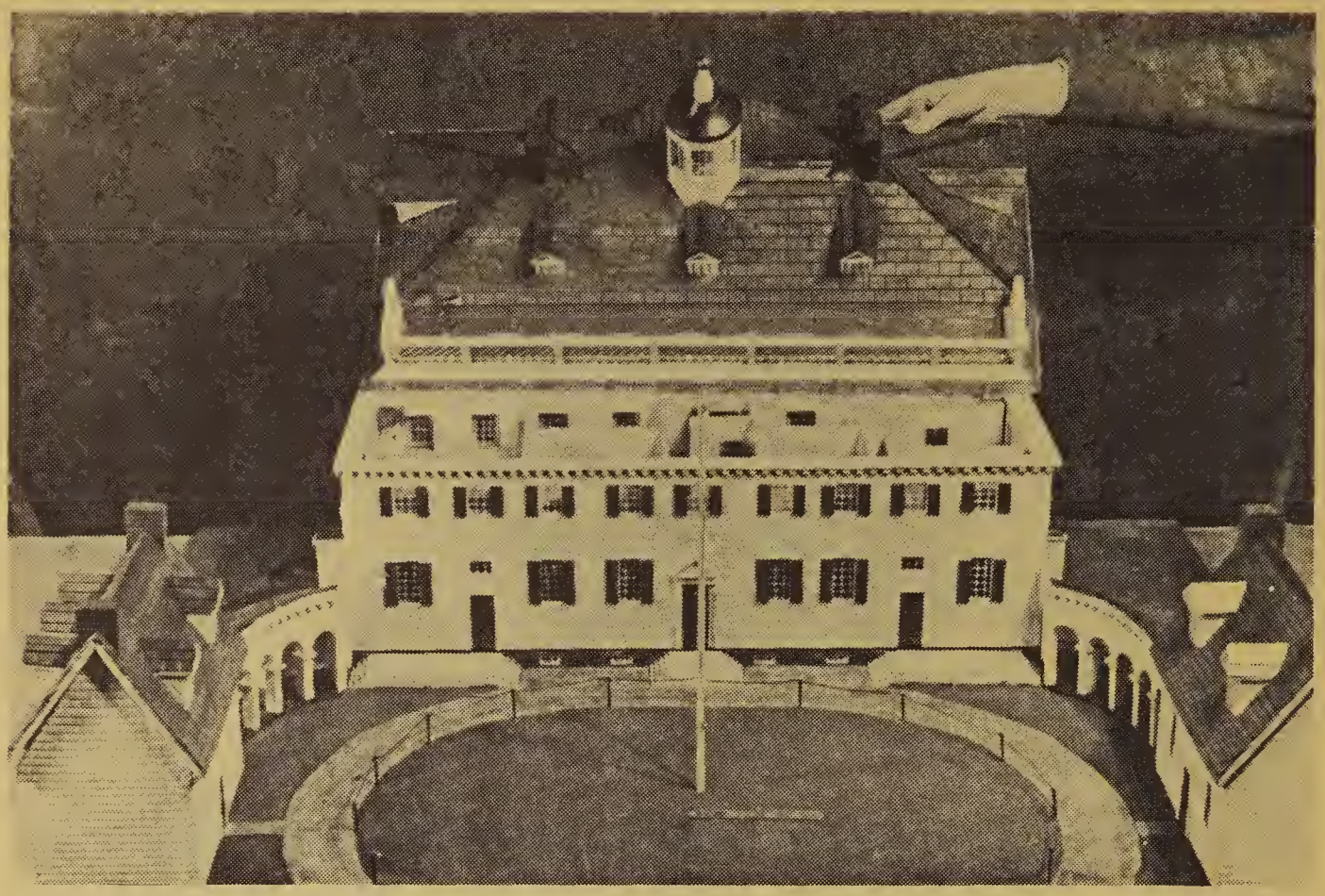
The foundation walls are of gray ashlar stone, topped by two courses of moulded brick. On their exterior, the walls (18 inches thick) are plastered a reddish buff, and scored lightly with a trowel. Corner quoins, five bricks high, extend past a horizontal brick band at the second story to the cornice. The hip roof is surmounted by a balustraded deck. Keyed lintels of brownish stone span window openings. Five different materials and colors are used in the front wall, which is 53 feet wide. Masses of green foliage complement a facade of uncommon richness. The north and south ends of the house, with the exception of the brick horizontal band, have neither openings nor decorative detail in their entire plastered expanse of 30 feet. Even the chimneys are concealed within the walls, emerging to seemingly enormous size above the roof.

The classic doorways and all exterior woodwork are painted white. A hall, 12 feet wide, bisects the main floor of the home; the stair hall is 8 feet wide. The wood trim is exquisite. Full three-by-seven-foot doors are decorated with classic wood frieze and pediment design. Wainscot paneling and mouldings of the second floor show later influence, but otherwise the trim is as beautifully tooled and delicate as that of the first floor.

The drawing room at the north end is 27 feet long and 18 feet wide. Its chimney is flanked by false doors, and in the opposite wall there is a shallow niche. To the left of the stairway lies the dining room. An inconspicuous service door in the south end of the room leads to the kitchen in the basement; the location hints the graceful living of a more leisurely time.

The height of Mount Pleasant enhances its stateliness. Ceilings are 12 feet high, and even cellar windows are placed above the ground and defined by frames of stone. Deck balusters and four narrow dormer windows at the roof level further emphasize the vertical lines. Twenty-four-paned windows and the classic doorway detail give an effect of stately gentility.

AMERICAN HISTORIC HOUSES



MT. VERNON

Length 36", Width 48", Height 22"

MOUNT VERNON

Mount Vernon, the plantation home of George Washington, is one of the Nation's most famous historical shrines. This charming mansion in the Southern Colonial tradition stands on the high west bank of the Potomac River in Virginia. The main section of Mount Vernon was erected in 1743, and enlarged by George Washington in 1773. A hipped roof with dormers, a banquet hall, a library, and the well-known two-story porch facing the river were added from plans made by Washington himself. Since stone and brick textures were best suited to eighteenth-century classic styles, the common practice followed was to cover the original clapboarding with sand-finished wood, paneled to simulate stone. Probably the most characteristic feature of the design was the long piazza, where the family and the many guests could gather in mild weather. A fine view of the river can be had from this vantage point, several hundred feet above the water.

The house itself is in the shape of a rectangle, 90 feet long and 30 feet deep. Surmounting the roof is a cupola and weather vane. Leading to the servants' quarters on the west front are two curved arcades, roofed and paved. In the courtyard at the west, there is a circular drive for vehicles; surrounding it are the buildings that served as kitchen, butlers' house, smoke house, dairy, wash house, coach house, store house, gardeners' house, spinning house, and servants' quarters. The flower garden, with its dwarf-box maze, and the large kitchen garden, which made Mount Vernon practically self-sustaining, lie beyond these structures.

Sixty-six servants were needed to take care of the estate, and a hundred fifty more to operate the four outlying farms. Activities of this little village of servants included the growing, spinning, and weaving of cotton, silk, and wool; the milling of corn and wheat; the pressing of wine; the distilling of whisky; the raising and curing of tobacco; the making and firing of brick; the hewing of lumber into beams and planks; the curing of meats; the making of butter and cheese; the gathering of eggs; and the care of all the animals on the estate.

Mount Vernon did not become a public memorial until 1860, when the mansion and 200 acres were bought by the Mount Vernon Ladies' Association to effect a restoration and to preserve the memory of Washington as farmer, father, and family man. Calmly aloof and leisurely decorous, this late-eighteenth-century plantation is host to hundreds of thousands of visitors, who come to pay homage to the great national hero.

ARLINGTON AMPHITHEATER

Length 51½", Width 40½", Height 9½"

ARLINGTON MEMORIAL AMPHITHEATER

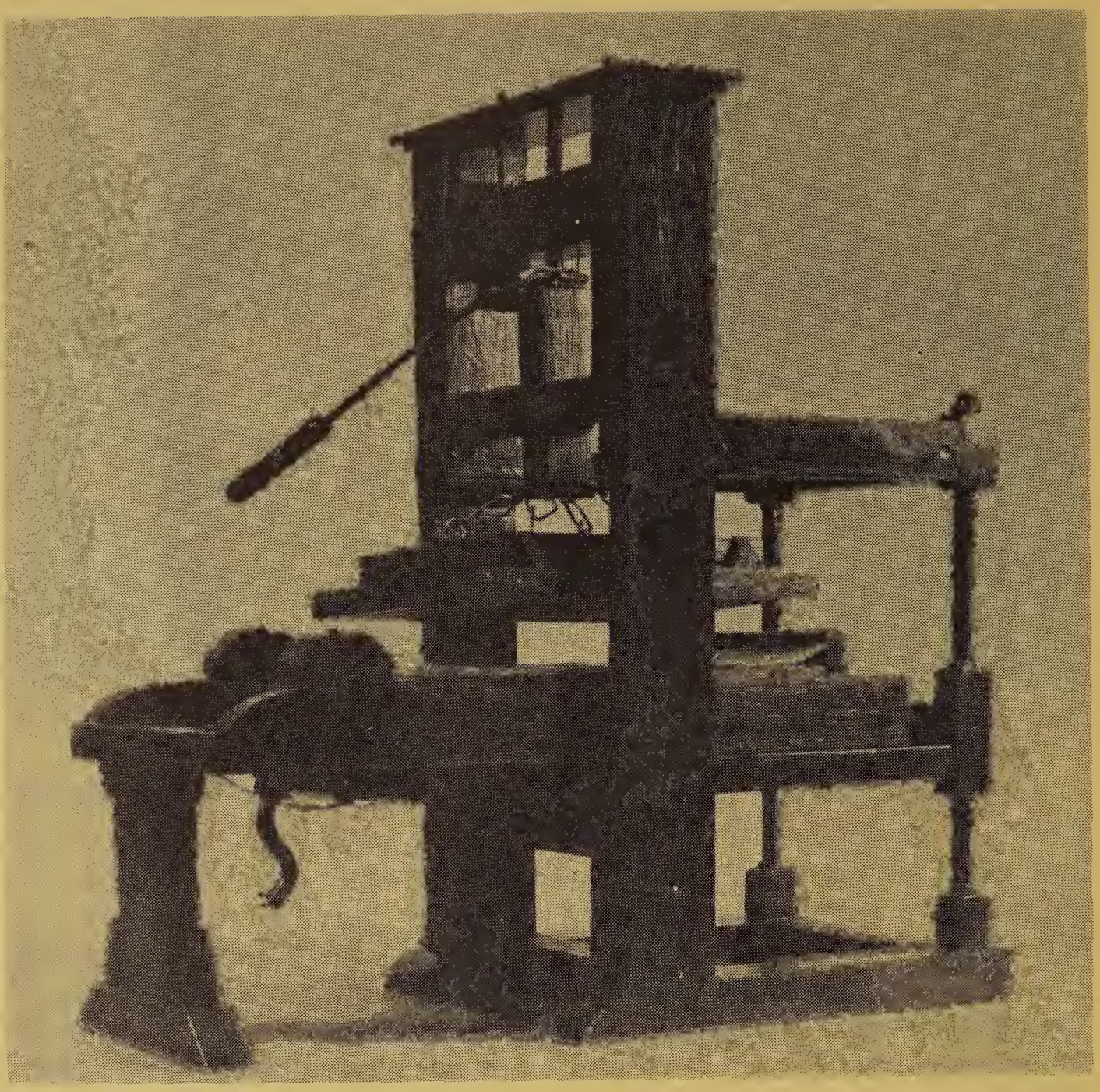
The Nation's commemoration of its soldier dead is centered each Memorial Day in the Memorial Amphitheater at Arlington National Cemetery. In 1868 the National Commander of the Grand Army of the Republic fixed May 30 as the day to decorate graves of the Civil War dead. It was not made a legal national holiday until 1888. Today many know it as Decoration Day. The portico of nearby Arlington House was the scene of the first Memorial Day service in the National Capital. Later when increasing crowds made a larger meeting place necessary, the ceremonies were held at the old amphitheater. By 1903, the services were so largely attended and of such national significance that plans for a new amphitheater were begun.

The site of the National Cemetery is not only one of the most scenic places in the environs of the capital, but also one of the most historically interesting. Martha Washington once owned it. Robert E. Lee lived in Arlington House, where he wrote his resignation from the Federal Army just before the Civil War. During the war, the estate became a training camp for soldiers, and part of the cordon of forts surrounding the city crossed its grounds.

Approaches to the cemetery are impressive. After crossing Arlington Memorial Bridge from the Lincoln Memorial plaza, one enters Memorial Parkway, a formally planted thoroughfare, and ascends a steep hill on the Virginia bank of the Potomac, coming at last to the Tomb of the Unknown Soldier, the Memorial Amphitheater, and Arlington House. An extensive lawn slopes gently up to the broad flight of steps that leads to a paved formal terrace and the Tomb of the Unknown Soldier at the west entrance to the amphitheater. Surrounding boxwoods and cedars soften the austerity of the plain marble tomb and the severity of line of the main entrance to the amphitheater.

The amphitheater was built as a memorial to the Army, Navy, and Marine Corps dead, and to serve as a gathering place for patriotic celebrations. The cornerstone was laid in 1915 by President Wilson, and the structure dedicated in 1920. A sloping, elliptical outdoor auditorium, that seats 4,000 people, is surrounded by a stately colonnade. At the west front is a pavillion, that, actually a separate building, houses a reception hall, trophy room, and stage on the main floor, a museum on the second floor, and a chapel in the basement. From the chapel there extends, under the colonnade, a circular hall in which, at regular intervals, there are crypts.

Emerging from the pavillion, one comes upon a scene of great dignity. A sea of marble benches is enclosed by the classic colonnade, the rim of which stands clear against the blue sky. Over the portico is a Latin inscription, which means: "It is sweet and seemly to die for one's country."



FRANKLIN PRINTING PRESS

Length 22½", Width 12", Height 24½"

FRANKLIN PRINTING PRESS

The first printing press brought to this country arrived in Cambridge, Massachusetts, in 1638. The first book from the press was the *Bay Psalm Book,* published in 1640. In 1733, Benjamin Franklin set up at Philadelphia a hand-operated, wooden-framed platen press that was typical of the printing machines used at that time. Stanhope's press of 1800 was the first iron-framed press. The first power-driven press was built in 1811. An American, George P. Gordon, in 1856 invented a light platen press that carried the type in vertical position. He called it the "Franklin," and it came into general use throughout the world, being the forerunner of modern presses of this kind.

Constant improvement and steady mechanization of printing processes have given us such great modern presses as those of the large newspapers; they are several stories high, weigh many tons, and deliver papers in neatly folded piles, ready to be sold by newsboys.

The printing press used by Benjamin Franklin was very crude compared with modern presses — and quite unlike them. It was a platen type of press, having a flat bed for the paper and a flat platen that held the type on its under side. To open the press, the platen was drawn up to the top of the frame by means of a large screw, and the bed thus exposed on the table of the frame. When ready to print, the printer rolled the face of the type evenly with an inking roller, and placed the type panel in the platen. He then spread a sheet of dampened paper on the upper side of the tympan, a thin wooden frame hinged to the bed. After the paper was smoothly laid in place, the printer turned the little crank at his side to run the paper into place under the platen. This accomplished, he turned the screw arm that pressed the platen down against the sheet of paper. Then he released the arm, and turned back the crank to bring the form out from under the platen. He was then ready to print another sheet. The model can be used to demonstrate this process. It is set with the words, "Benjamin Franklin Printing Press."

HISTORY

FRONTIER TOWN

Length 24", Width 30", Height 6½"

FRONTIER TOWN

When the white man first settled in North America, timber was the most abundant and most easily worked material in the wilderness. It was promptly made into homes, and, when the Indians became hostile, into defensive works. The fortified town of log cabins resembled the Roman forts built in the wooded sections of North Europe, and served their purpose as well. Palisades of wooden posts sharpened at the top made a formidable wall around the settlement. A blockhouse provided storage room and a place of last defense. It was usually built in one corner of the enclosure to give access to both the inside and outside for better defense, and to provide a chance to send for help. The model is that of a typical frontier town. Notice the rows of log houses set so that, in themselves, they form a unit of defense, receive a maximum amount of sunlight and air, and allow an open space for wagons, pack animals, and a drill and recreation ground. In the corners of the palisades are firing platforms, that, with the loopholes in the houses and blockhouse, permitted crossfire in any direction. In the model, the square has a pillory and stock, but these were not common in the early settlements. Discipline was more harsh and the law more direct before safe travel brought strangers on journeys from settlement to settlement. In all cases, the town had a good water supply, or could not survive. The stream in the model was probably supplemented by a spring inside the town for streams could be polluted and even diverted from their courses.

GRIST MILL

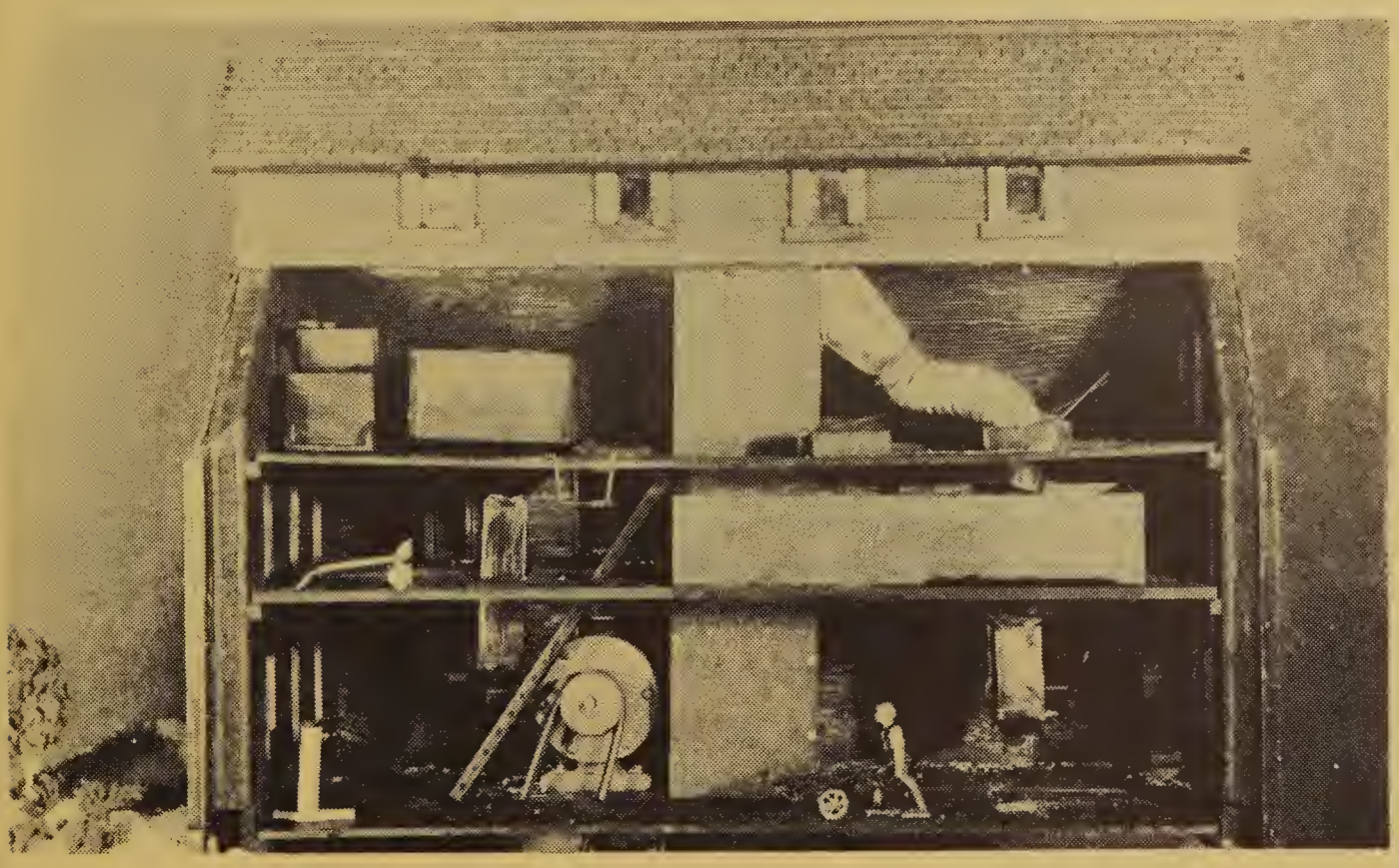
Length 30", Width 35", Height 54"

GRIST MILL

Soon after their arrival, the first settlers in this section of the country built water-powered mills to grind grain into flour. Many a pioneer town owes its existence to such a mill, which attracted people from miles around and made trading profitable. If the natural flow of the stream was not powerful enough to turn the wheel, a dam was built to accelerate the flow of water through gates in the dam and perhaps over a trough, called a "flume," that delivered a steady propelling force of water onto the wheel. Belts and pulleys transferred the power to the mill machinery.

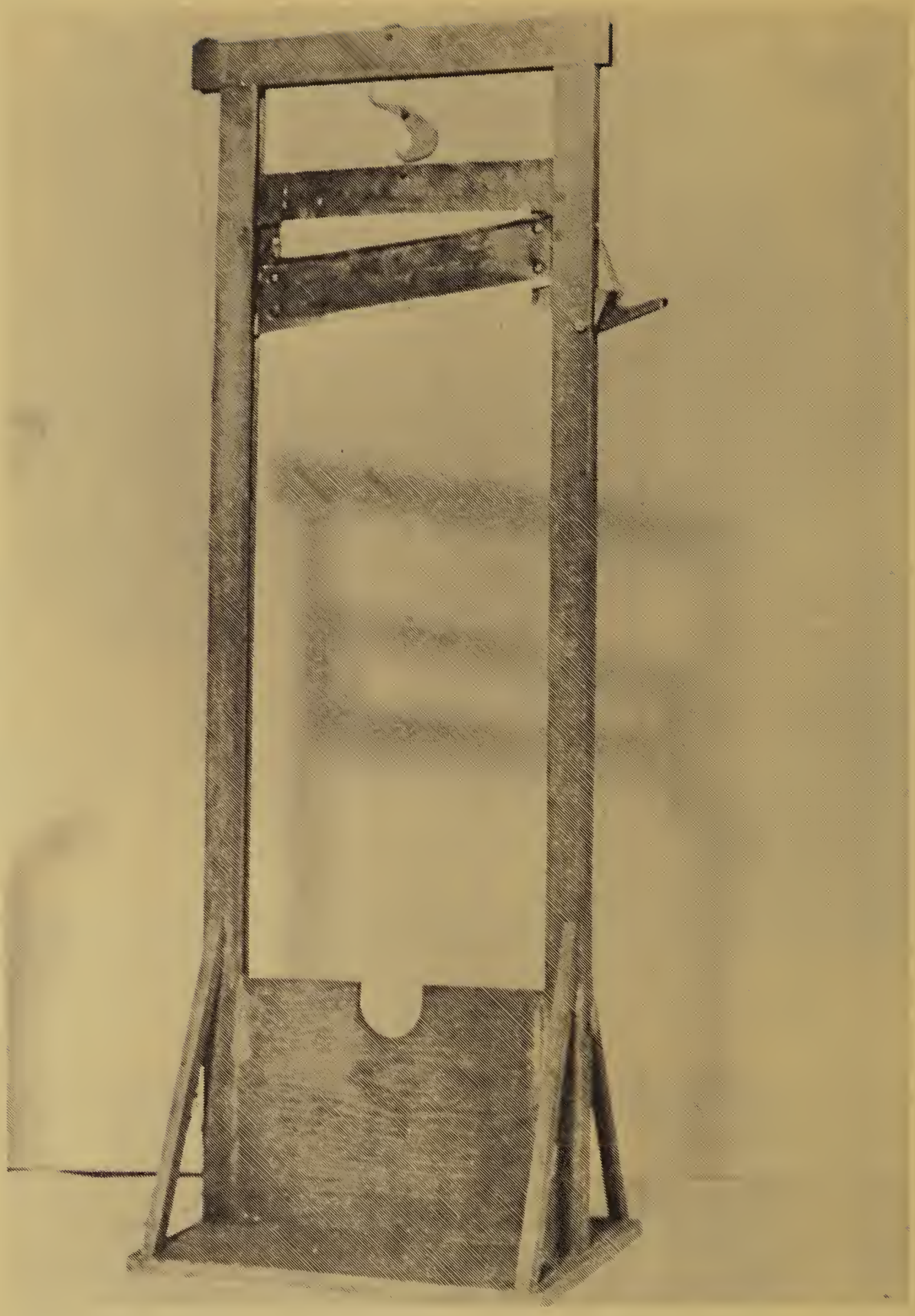
After the grain was weighed and cleaned, it was stored in bins directly over the grinder. It was then directed through a chute to the grinder hopper, and ground through the stone burrs of the mill. Thence it was sent to the upper floors, where it was stored in bins until it could be sifted, separated, weighed again, and finally bagged for market.

In some sections, mill operation was at a standstill in winter because of ice and snow. But, when spring thaws came, a man with a long pole was stationed at the wheel to shunt the ice chunks away from the paddles. Thus the inactivity of winter was followed by a period of activity in the spring. For the most part, however, operation of the old water wheels was a slow business, suited to lazy summer days and the leisurely tempo of the times.



GRIST MILL INTERIOR

HISTORY



GUILLOTINE

Length 12", Width 12½", Height 37"

GUILLOTINE

The guillotine is an instrument used to inflict capital punishment by decapitation. It is said to have been invented in Persia, but its most historic use was during the "Reign of Terror" in the French Revolution, when royal heads toppled hourly from the scaffold. It had been in use previously in England, Scotland, and various parts of Europe, and is still employed in some countries to mete out punishment for certain types of crime.

Framework of the machine consists of two vertical sideposts, with grooves to guide the knife in its fall from a locked position on the horizontal beam at the top, to the head block at the bottom of the rectangular structure. The heavy knife itself is beveled and weighted for a swift descent and a forceful, decisive chop. In addition, there is a steadying frame on the knife that rides in the groove to prevent slipping, catching, or jerking. A ring on the knife frame is caught by the hook at the end of the pulling rope to raise the knife into position. The release catch holds the blade in position until a pull on the lifting rope sends it hurtling downward. The model is a small replica of the guillotine on which Charlotte Corday heard the click and whir of impending death.

HISTORY

INDIAN VILLAGE

Length 36½", Width 30", Height 18"

INDIAN TEPEE VILLAGE

The word, *tepee,* comes from the language of the Dakota Indians, in which *ti* meant "to dwell," and *pi* "used for." The tepee was a conical tent of skins used by nomadic Indian tribes from northern New England throughout the central plains and bison country to northwestern Canada.

A frame for the tepee was made of about 20 stout sapling poles, set firmly in the ground in a 15-foot circle and tied together at the top with hide rope about 4 feet from the ends of the poles. Three or four of the cedar poles were larger; they carried the weight of the others. A covering was made from 15 to 18 dressed buffalo skins, that were cut, fitted, and sewn together to form a semicircular sheet. This sheet was then pegged or fastened with sod and stones at the bottom and secured to the wooden frame. An opening was left in the top through which smoke from the fire pit could escape. Although the fire pit was directly in the center under the opening, the wind made it necessary to have flaps of skin outside to prevent the smoke from blowing back into the tepee. These were held in place and moved by poles on the outside. The doorway, that usually faced east, was protected by a panther, coyote, or buffalo-calf skin, or was protected simply by an extension of the outside covering.

There were commonly three beds of willow rods, one on each side and one at the back of the tent. For greater comfort, the head of each bed was sometimes slung from a tripod in hammock fashion. Hand-decorated curtains kept rain from reaching the beds, and buffalo robes or blankets were used as coverings.

The model shows the men hunting and fishing, while the women perform the other work. It was a practice of nomadic Indians to follow the movement of game and to camp only where hunting was good. The hunter is stalking a deer against the wind, so that the wild animal will not catch his scent. Fish are numerous in the stream. The canoe paddled by one of the men is made of birch bark and is light enough to be carried from one stream to another if necessary. The log placed across the narrowest part of the stream serves as an easily movable bridge. Though strapped to his mother's back when traveling, the papoose is allowed to crawl about to develop his muscles. Tepees were rebuilt every year or so, and the completion of a new one called for a dedicatory ceremony. One of the Indians can be seen preparing a skin for a new tepee, while a squaw grinds maize for the winter's supply of meal.

ARCHITECTURE

JAMESTOWN CHURCH

Length 24½", Width 30½" Height 15"

JAMESTOWN CHURCH

A piece of sail stretched between trees, a wooden bar nailed to two trees for a pulpit, and rough log benches constituted the first place of public worship in the colony at Jamestown, Virginia. After the death of the first pastor, Reverend Robert Hunt, a rude, barn-like structure was raised in 1607. A covering of rafts, sedge, and earth formed the walls and roof. Two years after the structure had burned in an Indian raid in 1608, reconstruction was undertaken by Sir Thomas Gates. In ruins again when Captain Argall arrived in 1617, the church was moved to a new site.

The first Colonial legislative assembly met in this new house, and in 1639 the first brick church in the Colonies was built on this site to replace the wooden one. When Jamestown was burned during Bacon's Rebellion in 1676, the tower of this church and a few chimneys were all that remained of the settlement. On April 11, 1907, the National Society of Colonial Dames restored the church and presented it to the Association for the Preservation of Virginia Antiquities.

Several interesting pieces saved from the early church are still in Virginia. In Williamsburg are to be seen a chalice and paten of silver, gifts of Francis Morgson in 1661. In Alexandria there is a silver alms-basin, given by Sir Edmund Andros in 1694. A baptismal vase, donated by Martha Jaquelin in 1732, reposes in a Richmond church.

Supposedly completed in 1647, the original brick church was a plain, rectangular basilica, 56 by 28 feet, with high-pitched roofs. The pavement in the chancel was tile; in the nave, brick. Over the main doorway on the west front rose a 46-foot tower, 18 feet square at the base. Walls 3 feet thick diminished on the inside surface with each of 3 stories, until they were 17 inches thick at the belfry. Through opposite tower walls were cut arched doorways, one into the church and one to the outside. Above the main door was a second-story window, opposite which, in the east wall, a door opened into the church gallery. In the ruin, only two gaping 20-foot holes appear, because the masonry fell away between stories. In the third story of the tower, and probably in other parts of the church, there were loop-holes for protection in time of attack and also for added light. The restoration has a tower 36 feet high. The glazed headers of English bond masonry relieve the somberness of this sturdy church.

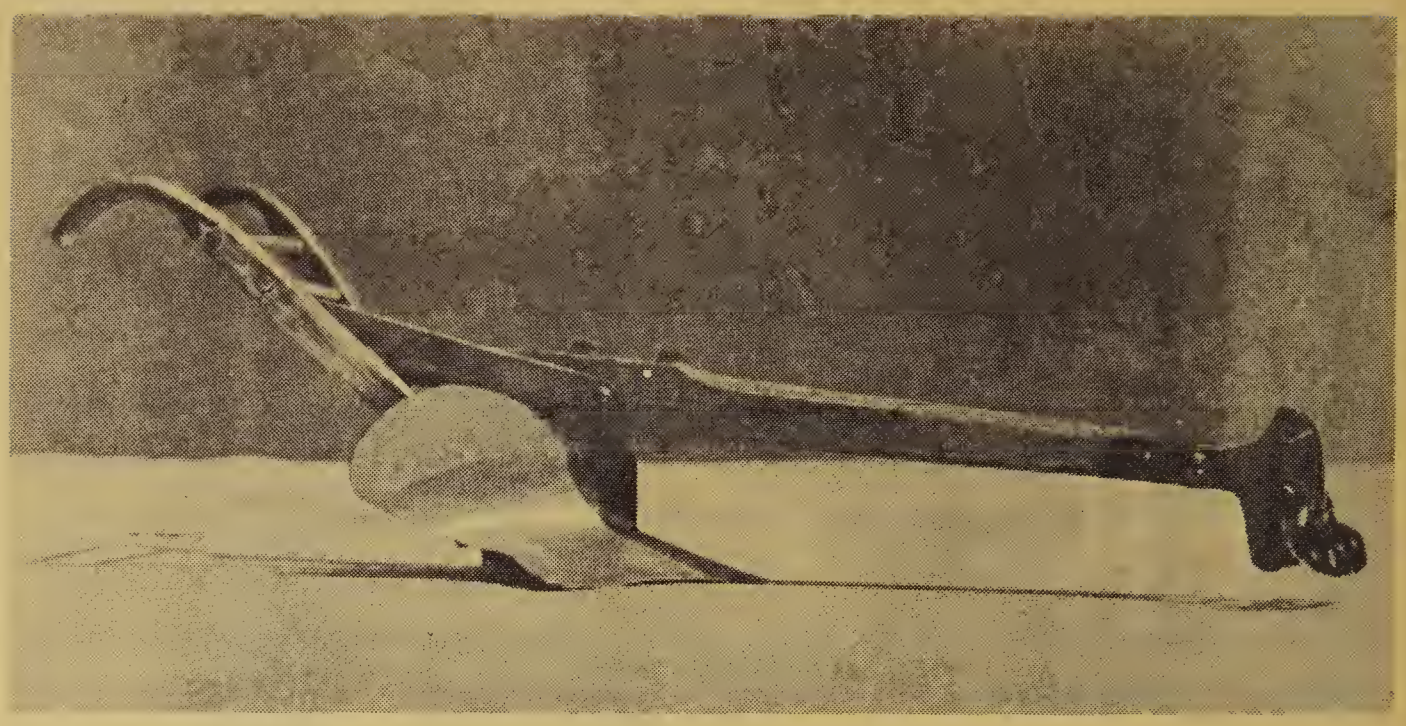
MOUND BUILDER

Length 14½", Width 14½", Height 16½"

MOUND BUILDER

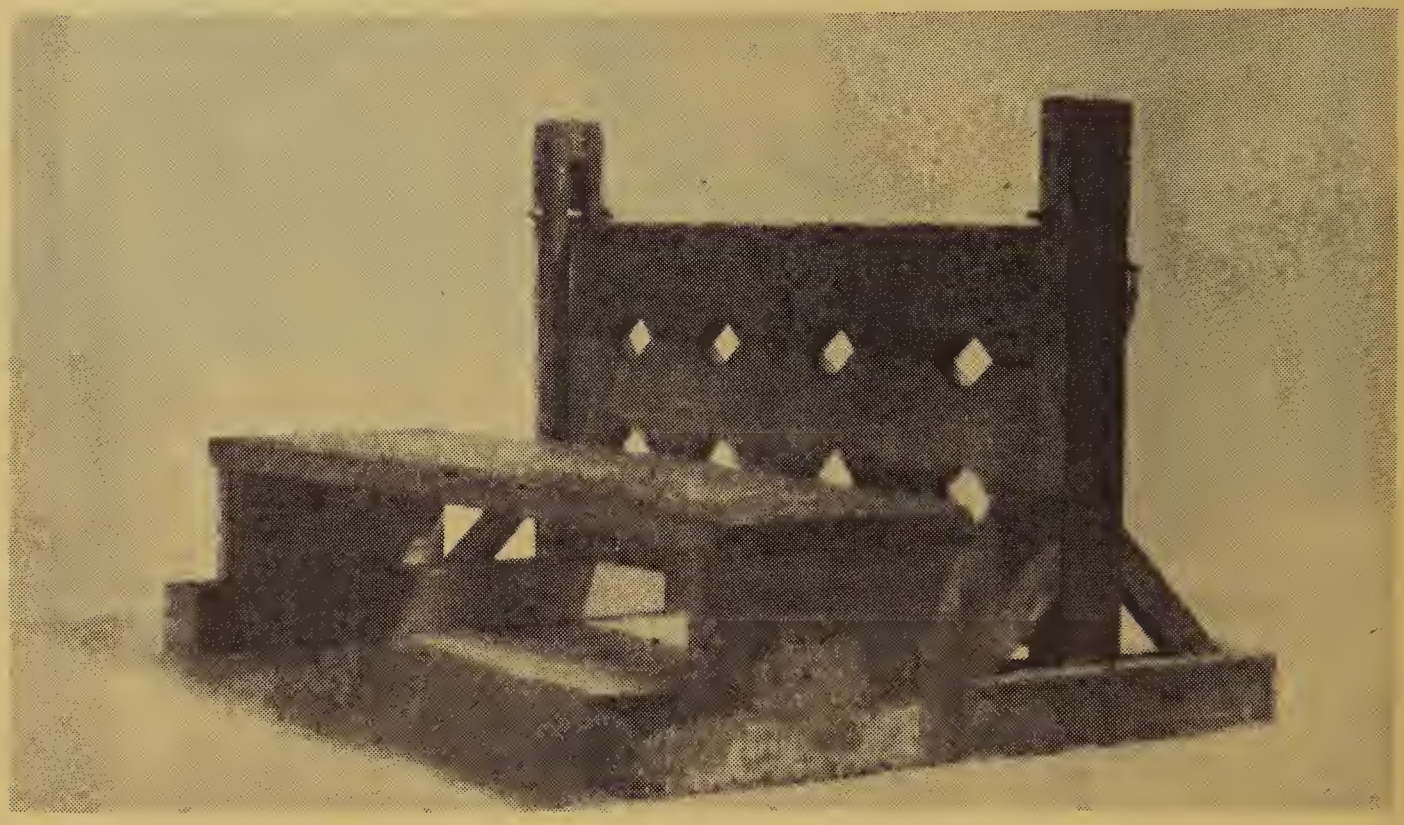
This model shows a Mound Builder in the act of carving a tobacco pipe from stone by means of a flint graving tool. Because the Ohio Mound Builders had great artistic skill in carving, they have been called "prehistoric sculptors." It must be remembered that these people belonged to the Stone Age, and as artisans knew nothing of the working of metals by processes of melting and molding. Though some of their metal work is surprisingly beautiful, it takes the form of hammered applique on wooden bases, which supply the required rigidity. In addition to ornaments of bone, mica, animal teeth, carved stone, and feathers, the Mound Builders wore fresh-water pearls. Imitation pearls were made of baked mud pellets, coated with a thin film of flexible mica.

The original from which this model was made is a life-size figure on display at the Ohio State Archaeological and Historical Society Museum. Measurements of actual skeletal remains and facial characteristics and musculature, taken from a full-blooded Indian, make this original sculpture in the round as authentic as possible. For ease in handling, the small model has been made in high bas-relief and mounted on a solid wooden frame, blended to form a background.



PLOW

Length 11½", Width 3½", Height 4"



PUNITIVE STOCKS

Length 23", Width 16", Height 13½"

PLOW

The plow is one of man's most important tools. In its earliest form, the plow was little more than a sharp stick, used to break the ground for planting. The stick was simply pushed into the ground. Later, in the valley of the Nile, the plow had evolved sufficiently so that man hitched oxen to pointed logs, directed into the ground by a plowman.

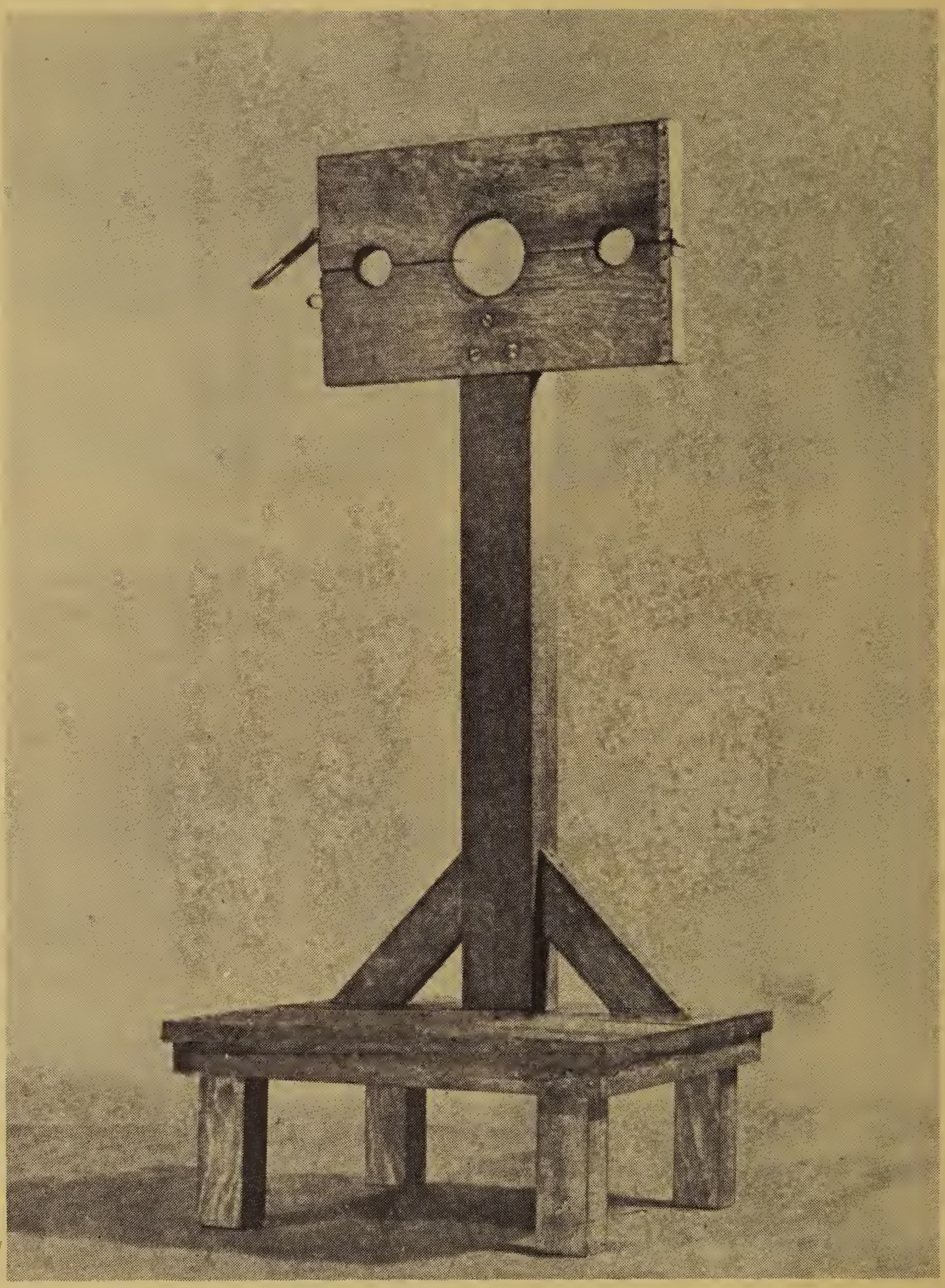
In principle, this was little different from the modern plow, although the many hundreds of intervening years have seen great improvements made. In the early 1800's, plows were of hard wood. (In some parts of the world, notably interior China, many wooden plows are still in use.) Next, they were made of iron. Since the latter part of the last century, the blades usually have been made of steel.

The most common plow used today is a general-purpose plow, commonly known as a turnplow, but also called walking plow, or moldboard plow. The largest part of its blade is called the moldboard, to which is attached the plow's actual point, the share. The share bites into the ground, while the rear moldboard, the larger part of the plow blade, turns the earth aside. When new, both these parts are so highly polished that they reflect images.

Other main parts of the plow, besides the blade, are the wood frame and the handles.

PUNITIVE STOCKS

A stock consisted of a ponderous upright frame in front of a bench on which the prisoners sat, their wrists and ankles locked into the holes of the frame. This uncomfortable position was maintained for the length of time imposed by sentence. The condemned rested their chins on top of the frame and contemplated the public square, while everyone was privileged to stare, tell jokes, and play pranks at their expense.



PILLORY

Length 12", Width 11½", Height 27½"

PILLORY

Punishment of criminals in eighteenth-century England and colonial America was often harsh. In England, there were more than 200 crimes punishable by death, including sheep stealing, pocket picking, and shop lifting of an article worth more than five shillings. In America, the code was somewhat more lenient.

In keeping with the practice then prevalent everywhere, executions were advertised as public spectacles. Handbills gave the name of the one to be punished, his criminal record, and a warning that all who followed in his footsteps would suffer a like fate.

For the lesser crimes, other punitive measures were devised. The tools of punishment included the pillory, stock, ducking stool, and whipping post. The ducking stool was used mainly to punish shrewish, scandal-mongering women. The whipping post was placed in a public place; offenders bound to it received their sentence of whip lashes on bared backs, the number of lashes varying with the seriousness of the crime. This form of punishment lasted more than a century after the Revolutionary War, and has been recently revived in some communities.

A pillory consisted of a wooden post, several feet high, at the top of which was mounted a rack with holes for the neck and wrists of the condemned person. This rack was hinged at one side, so that it could be opened for receipt of the culprit and locked against his escape. The wrongdoer thus stood in a cramped posture all day and sometimes throughout the night, unable to move except to shift his feet a little. In England, where it was used until 1837, the pillory was called a "stretch-neck." In France, it was known as the *carcan,* and was not used after 1832. The Germans called it a *Pranger.* In the United States, provision for punishment by the pillory appeared on the statute books until 1839, and the State of Delaware employed it until 1905.

HISTORY

PUEBLO

Length 36', Width 36", Height 11"

PUEBLO

Each year, thousands of American tourists travel to the Southwest to visit the famous pueblos. These structures, built by an ancient people, served as communal apartment dwellings, rising floor on floor to a height of sometimes seven stories. Pueblos were built of cement-like mud, of sun-dried clay bricks, or, in some cases, of sod. They are found in valleys, in cliff walls, and on top of mesas, table lands rising in sheer cliffs, hundreds of feet from the level valleys below.

It is said that early people in this area were scattered and nomadic. As a result of a movement toward concentration, probably owing to hostile pressure of some kind, towns and pueblos came into being. All these settlements — pueblos and walled towns of mud houses — were built with a view towards defense.

Interiors of the old pueblos were rudely decorated, and the furnishings roughly made. They were, however, well ventilated, being cool in summer and warm in winter. Cooking equipment comprised a stone-lined pit, hollowed out of the center of the floor, over which hung a kettle on a frame of forked sticks. Ladders were used to climb from one story to another. In many instances, the roof of one apartment held the garden of the family above; the chimney protruded in front of the door of the upper apartment.

Pueblos at Zuni, Taos, Acoma, Casa Grande, and Mesa Verde, those of the Rio Grande valley, and Pueblo Vonito are all worth examination, but perhaps the one at Acoma can be termed the most romantic, and the one at Taos, the most interesting — because of its age and good condition. The religious zealots at Taos have a very unusual celebration of the Passion week, including self-flagellation of the penitents and a realistic crucifixion. The model is an accurate reproduction of the mountain-guarded pueblo at Taos.

SEIP MOUND GROUP

Length 24", Width 30", Height 3"

SEIP MOUND GROUP

Since the Mound Builders possessed no written language and no time system, the only documents of their history that we can interpret are the relics and artifacts to be found on their camp sites and in their mounds. Archaeologists agree that the remains indicate several cultures in the civilization of these peoples. Although all the tribes were probably related as to race, they differed greatly among themselves in manners and customs. Some tribes were more highly civilized than others. The tradition of mound building was very important to some tribes; to others, it was only incidental. Some peoples placed their dead on top of the ground and piled earth on them in the form of a mound. Other peoples carefully prepared long structures within the mounds to receive their dead. This practice, along with snake worship, is reminiscent of the ancient peoples of the Old World.

The Seip Mound Group, on Paint Creek near Bainbridge, Ohio, belonged to one of the more civilized tribes of Mound Builders, who built log structures into their mound tombs. A site was carefully chosen, the ground cleared of all growth, and the earth leveled by the cutting down of high places and the filling in of low ones. Large posts were then sunk into the ground two or three feet deep and the same distance apart. Twigs and branches were woven into this log frame, and a thatched roof was built to cover the whole structure. A layer of fine sand and gravel, two inches thick, was then spread on the floor. Here, the dead were laid to rest. At a final ceremony, the structure was set ablaze, thus carrying out the modern idea of "purification by cremation." In the mound forms found today, remains of the burned building are completely covered with earth. In some instances, the bodies of the dead were cremated first and the ashes placed in the mound tomb later.

The Seip Group covers about a hundred acres. It consists of three figures, a square, and two circles different in size. The mound within the large circle was made up of three sections, each a separate charnel house. The bodies had been treated before burial, and subsequent burials made in layers of packed earth built up within the structure, which was not burned. In this group of mounds have been found tanned animal skins, "soft as chamois."

SERPENT MOUND

Length 18", Width 28", Height 9"

SERPENT MOUND

Awesome and mysterious is the Serpent Mound built by an ancient race on a bluff overlooking Brush Creek in Adams County, Ohio. The natural formation of the cliff bears out the belief it was a carefully chosen site and that, in the minds of the Mound Builders, this literally became "the place of the serpent." There is no doubt that it was a sacred shrine, for the vicinity is dotted with numerous burials, and the fire-blackened stones of an altar were found where pioneers, hunting gold and precious stones, had left them.

The only treasures found here to date are the artifacts taken from the graves. These consist of stone and bone weapons, copper head-and breast-plates that might be considered early attempts at body armor, and rude ornaments of crystal and of lead ore. Flint knives of remarkable design, as well as the shapers and grinders used to make them, have been found in abundance.

It has been concluded that Serpent Mound corresponds strikingly with similar mounds in Africa, Asia, and Europe, and that all were used in the same kind of worship. The dates of construction are still in doubt. In 1886, the trustees of Harvard's Peabody Fund bought the mound to save it for posterity. It has since come into the possession of the Ohio State Archaeological and Historical Society, and is now a state memorial.

Built on a sloping plateau, the effigy can be seen from quite a distance, and it is thought worshipers watched the priests perform their rites with fire and knife. First rays of the sun fall upon the altar, whence the priests could see the river forks. (A trinity of rivers or mountains is usually visible from the altars of serpent worshipers.) From the thrice-coiled tail of the snake effigy to the outside of the oval, or "egg," the distance is about 500 feet. Along the graceful convolutions of the serpent's body, the extended effigy measures 1,335 feet. Height of the artificial embankment averages four feet; it is highest at the center. The head and neck are extended, evidently to swallow the egg effigy, in the center of which still stand some of the big stones of the old altar. Beyond the egg are two converging lines of mounds, which, some authorities believe, represented a frog.

Serpent Mound is the only one of its kind in North America. Unlike the effigy mounds in Wisconsin, it has a stone foundation, evidently obtained from the creek bed by great labor and placed on ground cleared of all top soil. This foundation has preserved the mound from weathering.

STATUE OF LIBERTY

Length 11", Width 11", Height 40½"

STATUE OF LIBERTY

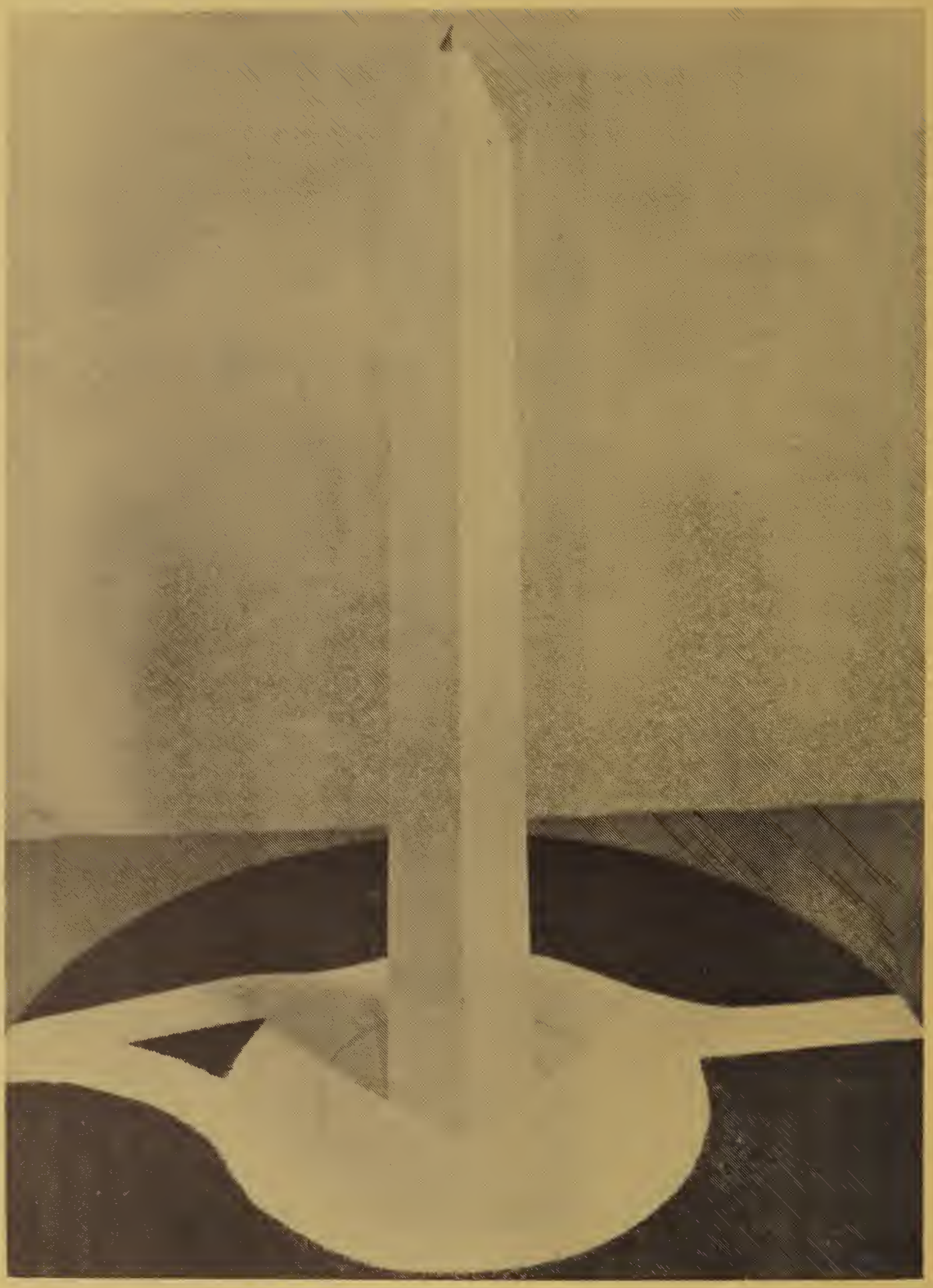
Erected on the star-shaped fortifications of old Fort Wood (1811 - 1877) on Bedloe's Island in New York Harbor, the Statue of Liberty commemorates the struggle for freedom of the peoples of the United States and France. This famous monument, given by the people of France as a gesture of good will to the people of this country, was the work of two Frenchmen, Frederick August Bartholdi and Alexander Gustave Eiffel. The figure of Liberty holds aloft the torch of Freedom and carries a tablet bearing the date, July 4, 1776, signifying Liberty based on Law. In the beacon torch are 14 one-thousand-watt lamps, which glow at night. Since 1931, there has been in operation a system of 96 similar lamps for flood-lighting the entire figure.

The cornerstone of the $300,000 pedestal was laid in 1884, and the $700,000 statue unveiled in 1886. The forearm was shown at the Philadelphia centennial celebration in 1876 and the 10-by-17-foot head was completed for the Paris exposition of 1878. Total height of the statue and pedestal is 305 feet; height of the statue alone, 151 feet. The statue is visited annually by about 250,000 people, who climb 161 steps to the top. Here 40 persons at a time can stand in the head and view the New York skyline through windows under the spiked crown.

In planning the statue, a clay model about nine feet high was made. This was enlarged four times, and revised. The enlarged model was then divided into four sections, and each individual part enlarged four times. Wooden forms of the divided model were built, and the copper sheeting of the finished statue was molded to them by pressing and hammering. Iron straps were used to strengthen the figure, and, to prevent galvanic action, asbestos cloth soaked in shellac was inserted. A skeletal iron frame was designed by Eiffel to support the figure of sheet copper against all possible stress. After the frame was in place, the 3/16-inch copper sheets were bolted on. The statue, with frame, weighs 225 tons; the sheeting itself, 100 tons.

As boats enter New York Harbor, the gigantic statue of Liberty looms against the western horizon, and the fantastic, fairy-like towers of the city rear skyward to the right. As the ships are towed to their berths beside Manhattan Island, the passengers are awed by the great size of the monument.

HISTORY



WASHINGTON MONUMENT

Length 31", Width 31", Height 32½"

WASHINGTON MONUMENT

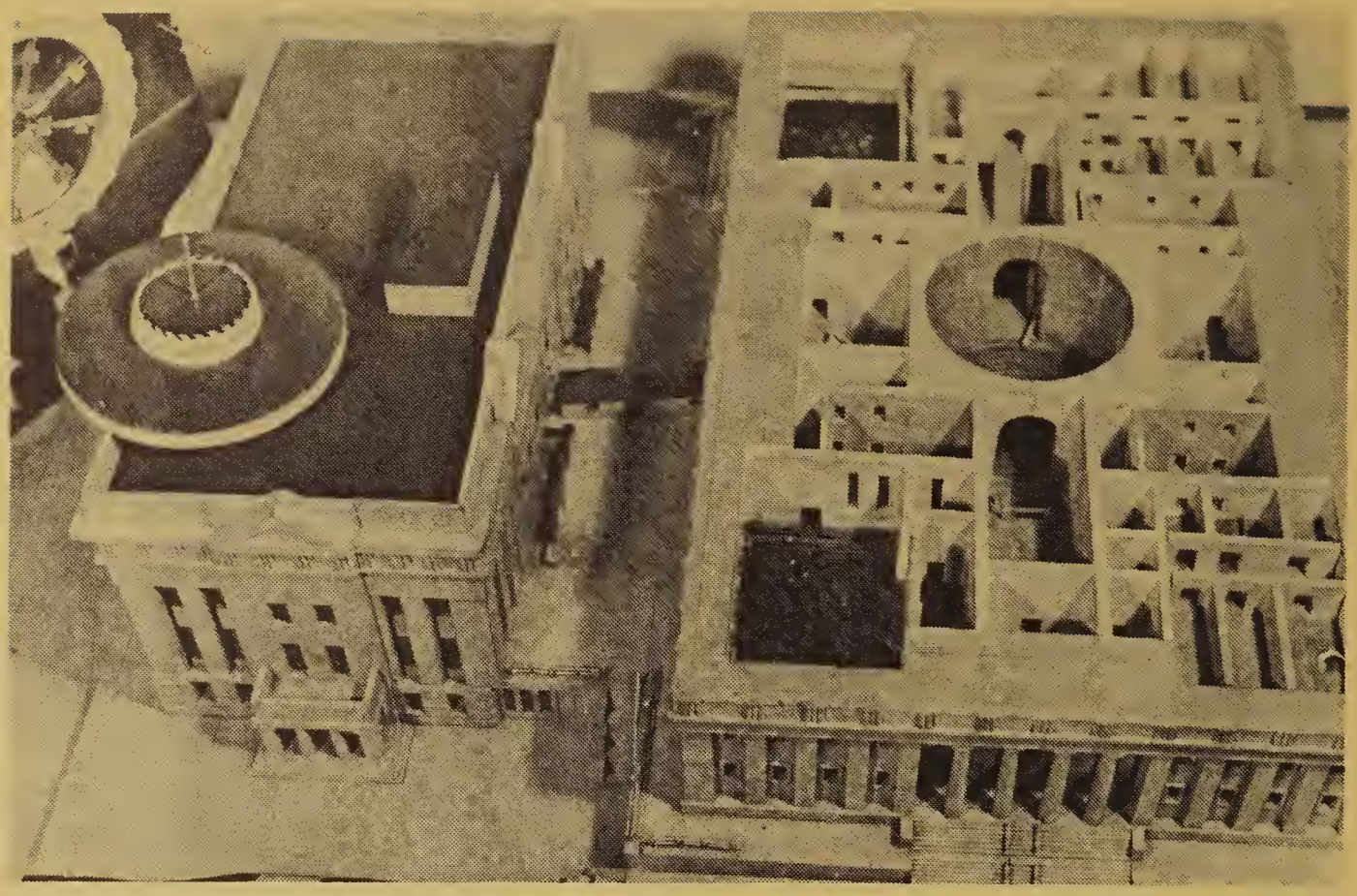
In 1783, before the British troops had been evacuated from the United States, Congress passed a resolution providing "that an equestrian statue of George Washington be erected at the place where the residence of Congress shall be established . . . the statue to be supported upon a marble pedestal on which should be represented four principal events of the war which he commanded in person . . . ."

When L'Enfant drew his plans for a Federal city in 1791, he included a place for this statue — about the same location as that of the present monument. But Washington, in all modesty, objected to any expenditure from the limited government resources, and the matter was dropped. Until 1848, nothing definite was done with regard to the proposed monument. In that year, Congress provided a site on public grounds, the cornerstone was laid with elaborate Masonic rites, and a call was issued for contributions. States, societies, fraternal orders, labor groups, colleges, churches, individuals, and many foreign powers sent properly inscribed stones. The gift of Pope Pius IX, a stone from a Roman ruin, was stolen and never recovered. All the others have been laid in the inner walls, so that visitors can pause on the stairs to read them. Utah's stone indicates that the State was known as Deseret at that time. There are many other stones from historic places, and some from ancient buildings. American citizens in foreign countries also were donors.

Robert Mills' plan originally called for a grandiose hodge-podge of all the notable ancient architecture. Washington was to appear, dressed in a toga, in a chariot drawn by horses led by a winged Victory. An immense Greek temple at the base was to be the American Pantheon, where statues of the Presidents and national heroes were to be placed. The monument was started along these lines, but work was interrupted until 1876, when only the idea of the central shaft was retained. The partly finished monument was poorly built. It was tilted, and required many delicate operations before work could continue. A traditional obelisk was decided upon, and the proportions of the structure were changed accordingly. The height was reduced from 700 to 555 feet, and a steeply inclined pyramidion replaced the squat cap originally intended. When completed in 1884, the aluminum cap was the largest block ever cast of that metal.

The monument is a hollow shaft without decoration or embellishment other than the entrance door and the paired windows on each of the four sides at the 500-foot level. It is the tallest piece of masonry work in existence. Its wall taper from 15 feet thick at the base to 18 inches at the top. In 1900, the steam hoist used to carry visitors to the top was abandoned in favor of electric elevators. There are 898 steps to the top, the magnificent view from which compares well with those of taller structures. Clouds and sunshine make many unusual shadow effects on the white surface of the monument.

CAPITOLS



OHIO STATE CAPITOL

Length 43½", Width 36", Height 19"

STATE CAPITOL

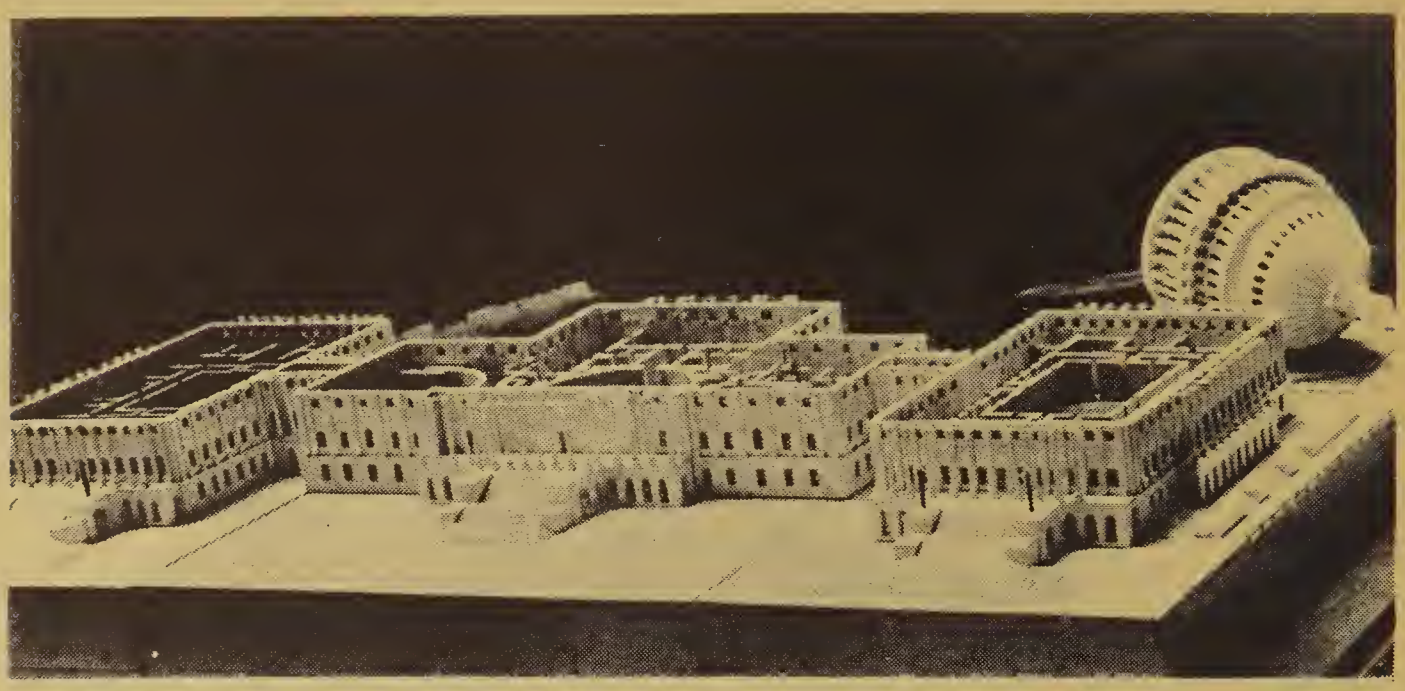
Since 1816, Ohio's capitol has stood on the same 10-acre plot of ground set aside for it in 1812. During the previous quarter of a century, the capital had been shuttled from place to place, with Cincinnati, Chillicothe, Zanesville, and Chillicothe successive locations, before it was moved to "the high bank of the Scioto." Here the first Statehouse was a structure with a hipped roof, the cupola of which reached a height of 106 feet, where a balcony afforded a vista of woods and rivers for miles around. In 1838, the legislature passed an act providing for a new Statehouse. The building material decided on was native limestone, taken from a quarry three miles northwest of the square.

After the 12- to 15- foot foundation had been laid, and the cornerstone placed by Governor Morrow in 1839, the enabling act providing for the building was repealed and work suspended until 1846. In 1849, steam-driven machinery was installed, and, with larger subsequent appropriations, the work went forward rapidly. The old Statehouse burned in 1852, and some of its brick, made from the clay of an ancient local mound, was incorporated in the new building.

Since convict labor was largely used, the estimated cost of the structure was $400,000. However, delays and unforeseen conditions, including a cholera epidemic, brought the final cost to $1,644,000. Although the new building housed the legislature in 1857, it was not officially completed until 1861. Fifteen years had been spent in the actual construction. By 1899, the increase in State business necessitated the building of the Judiciary Annex, at a cost of $400,000, to house the Supreme Court and other offices.

Diameter of the rotunda is 65 feet; interior height of the dome, 125 feet. Width of the four entrance foyers is roughly 24 feet, and height of their arches 36 feet. The handsome rotunda floor comprises thousands of inlaid blocks of colored marble, and tells symbolically the story of the growth of the United States. Stairways, columns, floors, and desks of the members of the legislature are of white marble from Italy and colored marble from Pennsylvania and Tennessee. Off the north foyer are the offices of the Governor and the Secretary of State, and, in the south foyer, those of the State Auditor and Treasurer. The House of Representatives, in the southeast quarter of the second floor, has galleries around three sides of the room. In the Senate Chamber, northeast quarter, are elevated tiers of seats for visitors. Many relics and objects of art are housed in the rooms and corridors.

At one time, the Statehouse was the tallest building in the Columbus skyline, and thousands of people climbed the spiral stairs to its dome to view the city. When built, it was one of the largest State capitols in the Nation, and today remains one of the few public buildings of its style and period serving its original purpose. This venerable structure seems to symbolize, especially in its sturdy proportions, the spirit of Ohio.



NATIONAL CAPITOL

Length 43½", Width 64½", Height 25½"

NATIONAL CAPITOL

The Capitol at Washington, D. C., is the foremost symbol of the Government of the United States. In 1793, President George Washington and Secretary of State Thomas Jefferson selected the winning plan of a competition, and protected it from proposed alterations. President Washington presided at the laying of the cornerstone that year, and by 1800 part of the building was in use. The British fired the building during the War of 1812, necessitating restoration work that was not completed until 1819.

The business of national government grew so fast that additional space was soon needed in the Capitol. In 1850, Congress appointed Thomas U. Walter to build two new wings, to be connected by corridors with the old building. The great dome, which has come to mean so much to Americans, was planned mainly to balance and supplement the extensions on each side. When the Civil War began, the dome was just beginning to take shape. Instead of urging that the work cease, President Lincoln insisted that construction be pushed, for he felt that the great iron dome, symbolizing union, would hearten the people at this grave time. Historians are agreed that it helped.

The Capitol is 750 feet long and about half that amount wide, and it rises 285 feet above the eastern plaza. The gracefulness of the great dome imparts a sense of grandeur to the otherwise rather low-lying building. A 20-foot statue of "Freedom," by Crawford, tops the structure, and the pediments carry many sculptured symbolic figures. The classic columns, terraces, balustrades, arcades, and wide steps make a templelike approach.

The plain, dignified legislative chambers actually take up less than half the interior space of the building. Committee rooms, document rooms, clerks' offices, cloakrooms, lunchrooms, reception rooms, and legislative members' rooms form the rest of the background for the business of governing one of the biggest nations on earth.

COVERED BRIDGE

Length 38", Width 20", Height 17"

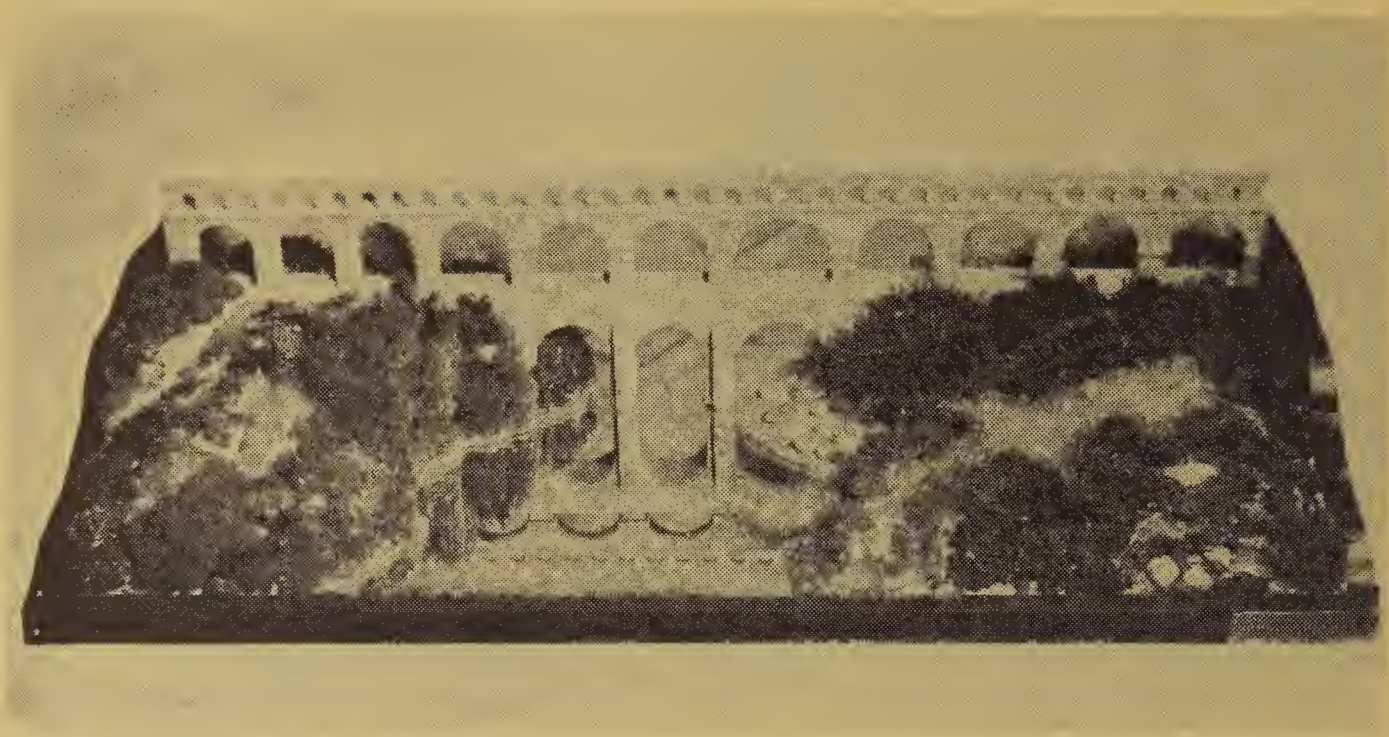
COVERED BRIDGE

Though water courses were the avenues by which this continent was first settled, civilization did not follow until barriers to land routes were removed. Logs placed from one side of a stream to the other served as the first bridges. For many years there were no bridges for wagons, and drivers were forced to go miles out of their way in order to ford rivers and streams. Pack horses and cattle were made to swim across the water barriers.

Since carpenters usually built covered bridges, it was only natural that they followed the forms they used in house-and barn-building. First bridges were of roughly hewn logs built on piers of stones held together by mud or rude cement. Sometimes it was necessary to divert a stream from its course in order to place supporting log piers in the center of the bridge. These were buried in the stream bed at their lower end, and the stream was returned to its channel when the work was finished. Girders for the bridge were long wood beams. A floor was made of heavy hewn boards laid crosswise over the girders. A roof and walls enclosed top and sides against weathering. Through cracks in the walls and where walls met floor, one could see the water below. The roof was necessarily quite low, leaving barely enough room for stage coaches and hay-filled wagons to pass. Cross beams of the gable roof often caused the drivers to duck. Roofing shingles were made by hand from split logs, or, in rare instances, from birch bark. Since these bridges were of necessity placed at the lowest point in a stream or at the most suitable place for foundations, roads accordingly followed the bridge locations. In time of storm, the covered bridge offered shelter to the traveler.

The oldest covered bridge in the world (the Kappel bridge, built in 1333) stands at Lucerne, Switzerland. It is 12 feet wide, and still used as a foot bridge.

BRIDGES



ROMAN AQUEDUCT

Length 38", Width 21", Height 9"

ROMAN AQUEDUCT

Among the works of the Romans that compare favorably with similar modern structures are the aqueducts, through which water was fed to their cities. Rome itself had an extensive system of these public works. It is interesting to note the prideful attitude of one of the Roman officials, who asked, "Who will compare the idle Pyramids or those famous but useless Greek structures with these many indispensable aqueducts?" At the same time, he remarked that much water was lost to the land owners, who tapped the supply on its way to the city; to the watermen, who regulated their metered tanks so that they had a surplus for sale; and to the citizens, who thought nothing of tapping mains supplying public institutions and fountains.

There were aqueducts and water systems before Rome was great, but it was the Roman arch and the use of concrete that permitted Rome's water supply to grow with the city.

Water conduits of the ancient world allowed a free-flowing surface through gently sloping channels; they were built as canals, covered conduits, and tunnels. Although one of these waterways extended all of 60 miles from Rome, most of the Roman aqueducts were from 15 to 20 miles long. Near Nimes, France, is the Pont du Gard aqueduct, a provincial Roman waterway unmatched for bold conception and graceful arches. The bridge is 160 feet high and built in 3 tiers. The bottom arches have a span of 60 to 75 feet, the middle arches are 75 feet wide, and the small top arches directly supporting the water channel span less than 20 feet. Much of the beauty of this work comes from its location; for the valley it straddles has gently sloping sides that allowed a nicety of proportion.

The three largest aqueducts in the United States are the 223-mile system from the Sierra Nevada Mountains to Los Angeles, the 156-mile San Francisco Hetch Hetchy aqueduct, and the Catskill Mountains-to-New York supply line running through 90 miles of rough country. In modern construction, pressure conduits are used; they consist of pipes and tunnels subject to heavy stress.

STEEL TRUSS BRIDGE

Length 59½", Width 15", Height 13½"

SUSPENSION BRIDGE

Length 14", Width 50½", Height 13"

STEEL TRUSS BRIDGE

The first truss bridge was probably a simple triangle; from this have evolved the modern trussed bridges of many connected triangles. The triangle is the only polygon the shape of which cannot be altered without changing the length of any side. Thus stresses are limited to those of tension and compression over the rigid, webbed framework of beams, bars, rods, and the like. External forces acting on a bridge are the dead load, or weight, of the bridge itself, and the live load, or traffic.

The model is a replica of a highway bridge over the Wabash River in Mercer County, Ohio. There is no overhead lateral bracing, and at each end are abutments of stone or concrete, on which rests the bridge structure. The beams that carry the floor the full length of the bridge are called joists, or stringers. Rockers are introduced at the proper place to allow for expansion and contraction of the steel under temperature changes. Steel beams, of which the trusses are made, are riveted onto the flat plates known as gussets.

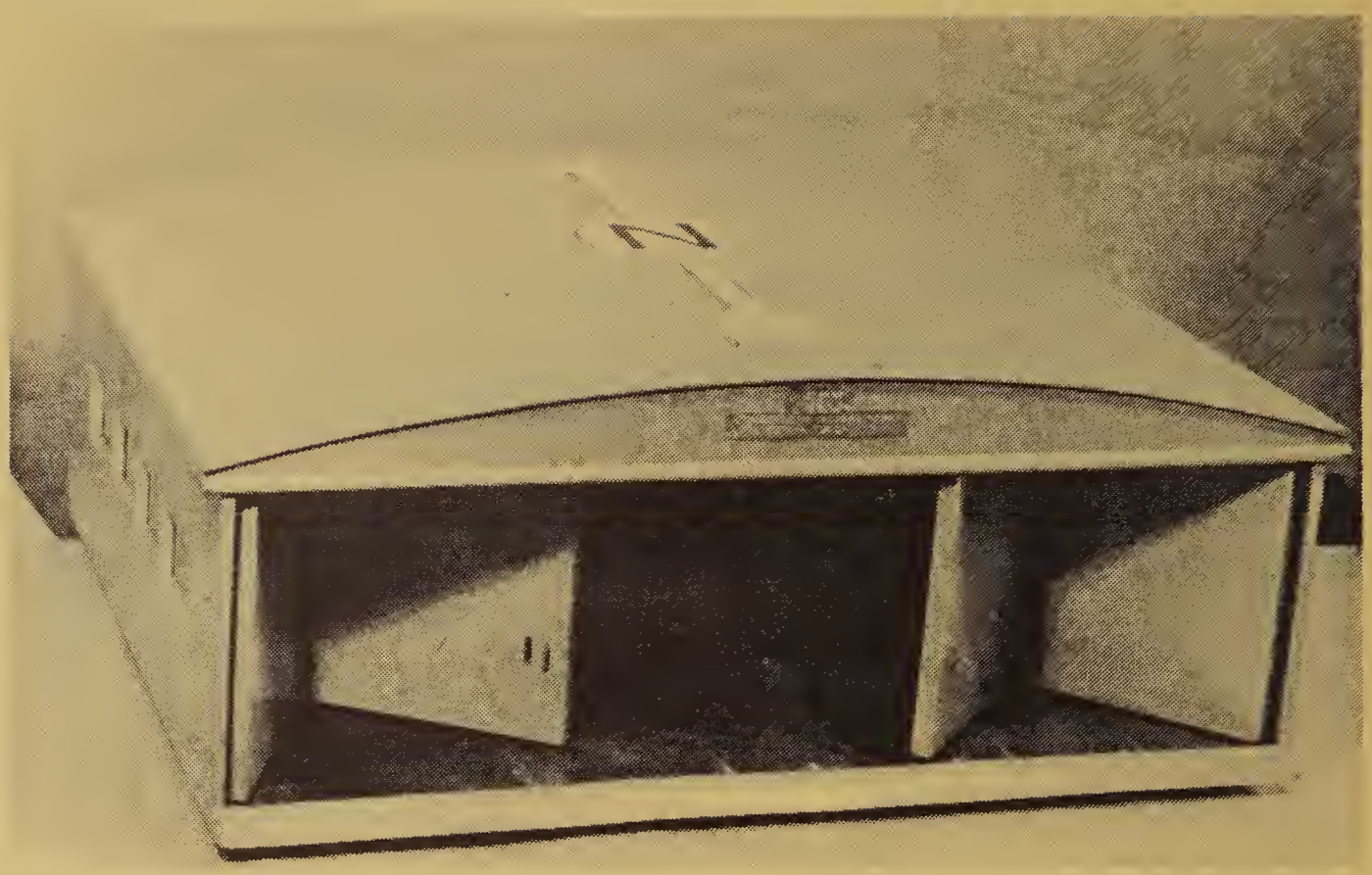
Simple steel truss bridges are generally built in span lengths of a hundred feet or more. This bridge is 115 feet long and 30 wide, and so built that load distribution is equal at all points.

SUSPENSION BRIDGE

Primitive suspension bridges made from vine ropes are found in tropical countries. Civilized man builds them of steel cables supported on towers and anchored by piers. This type of bridge is capable of the longest span, its theoretical limit being about 7,000 feet. There are two supporting towers, which may be of masonry or steel-truss construction. These carry the main load through an interlacing web of steel cables that hang upon them. The tendency toward swaying when traffic moves across the bridge is allayed by stiffening girders, placed at road level. Some famous structures of this type are the Brooklyn, Manhattan, and George Washington bridges and the one at Cincinnati, said to be the first in America.

The bridge at Point Pleasant, West Virginia, is unusual in that eye-bars were used instead of cables.

AIR TRANSPORTATION



AIRPLANE HANGAR

Length 36", Width 40½", Height 16½"

AIRPLANE HANGAR

At one time there were five air fields in Columbus: Norton, Clickenger, and Linden Fields, Columbus Airport, and Port Columbus. The model is a replica of the hangar at Columbus Airport, the city's second-oldest flying field. All mail planes landed at Columbus Airport from 1928, when it was built, until 1930. The hangar was constructed of steel girders and supports, covered with corrugated steel sheeting. This covering was not riveted on, but "toe-nailed" — that is, steel spikes were bent around the girder framework. The field is a good example of the type of field on which many aviation notables served their apprenticeship. Its 350 acres are grass-covered except for the cinder runways, which cross them diagonally from the northeast and northwest. To carry the weight of great air liners and army bombers, modern fields must have concrete or asphalt runways. The conventional hangar is made of steel and concrete or brick, and commands high rentals. A new multiple hangar — which houses planes in stalls so that the wings of one plane dovetail with the tails of the two adjacent planes — provides cheaper housing for privately owned planes. The largest floor space ever enclosed under one roof is that of the Goodyear Zeppelin Dock, a hangar for dirigibles at Akron, Ohio.

When Columbus Airport was first built, it was a gala place on evenings when crowds drove out to see the mail planes arrive. The tense, subdued excitement just before the arrival of the plane was reminiscent of the day when it was a popular pastime to meet incoming trains. Aviation classes, commercial planes, and "rides over the city" now constitute the activity at the field.

Gleaming air liners now pass it by and use the huge new Port Columbus, situated east of the city. This mile-square airport, criss-crossed by hard-surfaced runways, is one of the Nation's finest.

AIR TRANSPORTATION

AUTOGIRO

Length 34", Width 34", Height 14"

AUTOGIRO

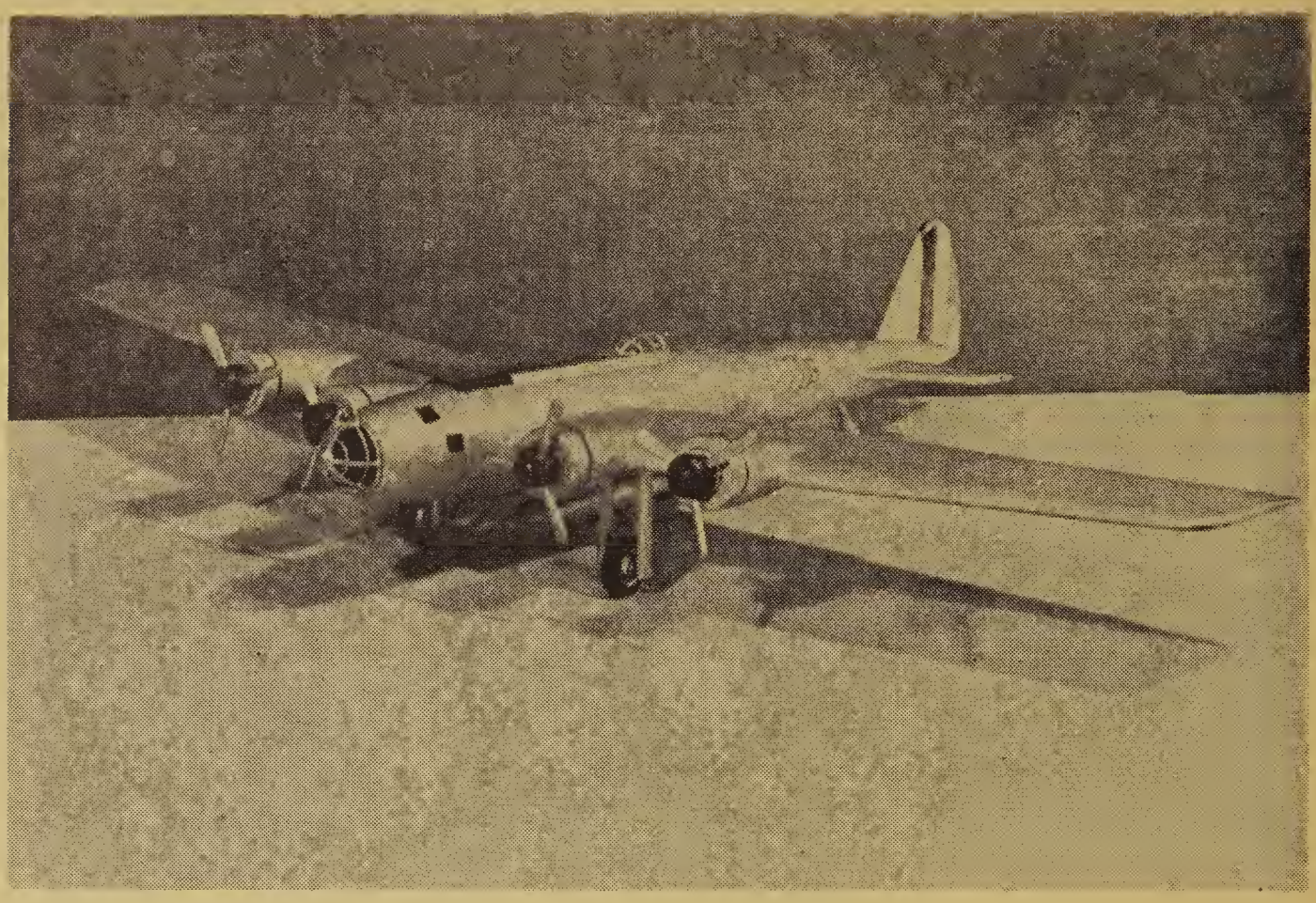
The autogiro was invented and perfected by Juan de la Cierva, a Spaniard, between 1919 and 1925. The new type of plane ascends and descends vertically, eliminating running take-offs of several hundred yards over necessarily level terrain. To date, it is the nearest approach to a fool-proof plane for use of the average man, since it floats to earth almost in parachute style.

An autogiro differs from the conventional airplane in that its wings extend above it in the shape of a cross and rotate like a windmill, thus enlisting the principle of direct lifting. The rotors, as these wings are called, turn by the force of air currents alone. Forward propulsion is obtained from a motor-driven propellor on the nose of the plane. In this way, there are two forces, the forward thrust of the propeller and the lifting, or suspension power, of the rotors.

Although relatively safe, the autogiro is inferior to the ordinary plane in speed and carrying capacity. This type of plane, however, is used to carry mail at Philadelphia, alighting and taking off from the roof of the post office. Anticipating a demand for low-priced autogiros, a Philadelphia concern makes one which folds so that it can be driven along the highway from the flying field to the owner's home and stored in a two-car garage. This eliminates expensive storage, one of the biggest drawbacks to plane ownership by the man in average circumstances.

The helicopter differs from the autogiro in that its rotor wings are motor-driven, giving a more marked ability to climb and land vertically, though a tremendous amount of power is required to sustain it, and its controls have not been perfected. In the air, however, as with the autogiro, engine failure presents much less of a hazard than is the case with an ordinary plane.

AIR TRANSPORTATION



BOEING FLYING FORTRESS

Length 26", Width 36", Height 6½"

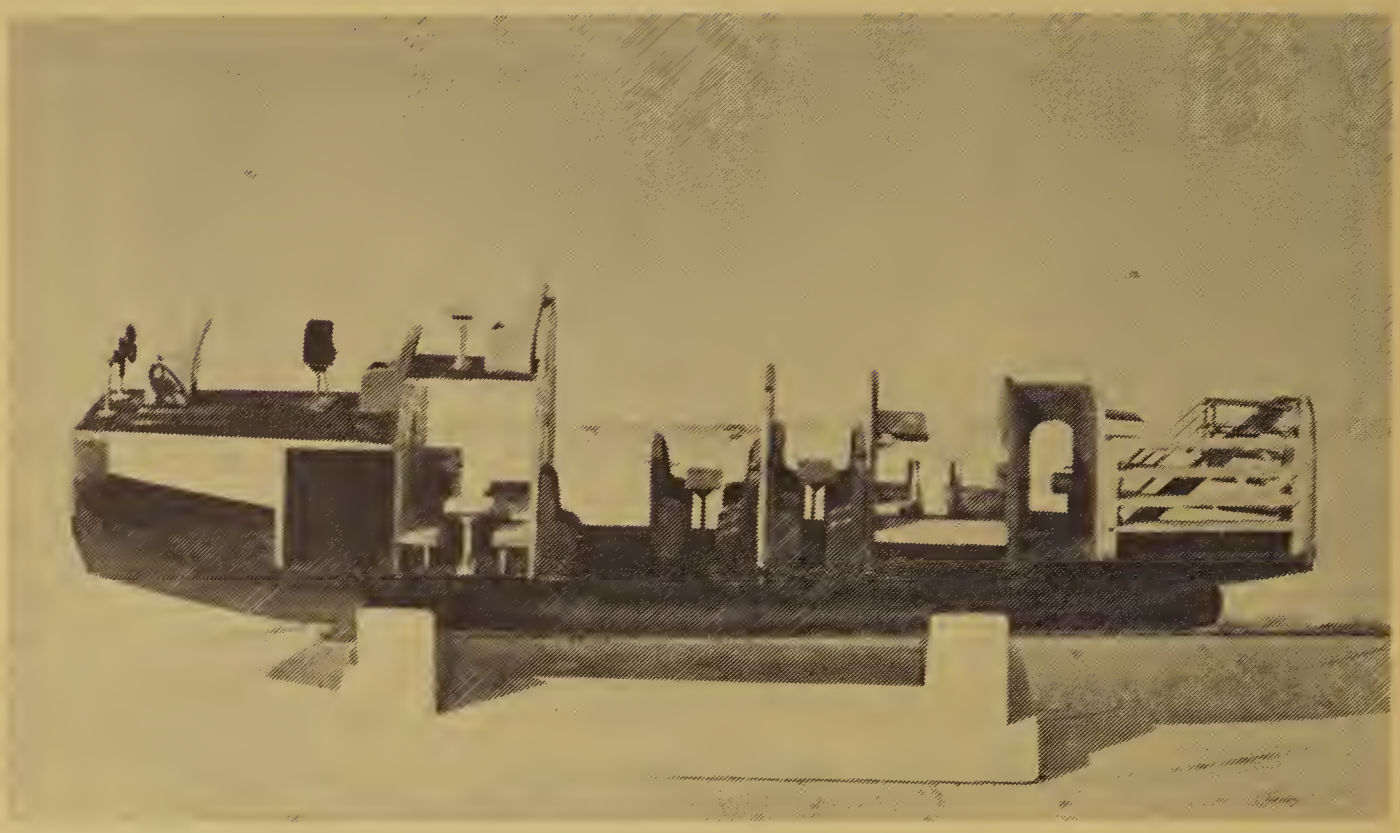
BOEING FLYING FORTRESS

Within recent years, the United States developed the Boeing Flying Fortress. Equipped with machine guns, light cannon, and bombs, it is designed to proceed to its objective, bomb it, and return to its own lines with all possible dispatch. It can outrace most pursuit planes, achieving a top speed of 250 miles an hour. In the delivery of the first of these ships, the 2100-mile trip from Boeing's Seattle plant to the Dayton air field was made in 9 hours.

The bomber is a low monoplane with retractable landing gear. It weighs 30,000 pounds, carries 6 tons of bombs, climbs to 25,000 feet, and flies 2,500 miles without refueling. Of three-ply metal construction, the ship is powered with four 800-horsepower Wasp motors that are paired on each cantilevered wing. The plane measures 105 feet from wing tip to wing tip and 70 feet from nose to tail, and stands 15 feet high.

Since bombing devices of the United States air force are secret, the bomb holder in the model is not accurate. It contains a scaled-down replica of a 500-pound bomb. The bomber is also equipped with five-gun emplacements, allowing complete coverage from all angles by heavy-caliber gunfire. Three of the emplacements are built into streamlined "blisters," which protrude from the sides of the ship. The nose of the plane, made of bullet-proof glass, shelters the bomber member of the crew, who telephones orders back to the bomb hold.

AIR TRANSPORTATION



CHINA CLIPPER

Length 31", Width 43", Height 9½"

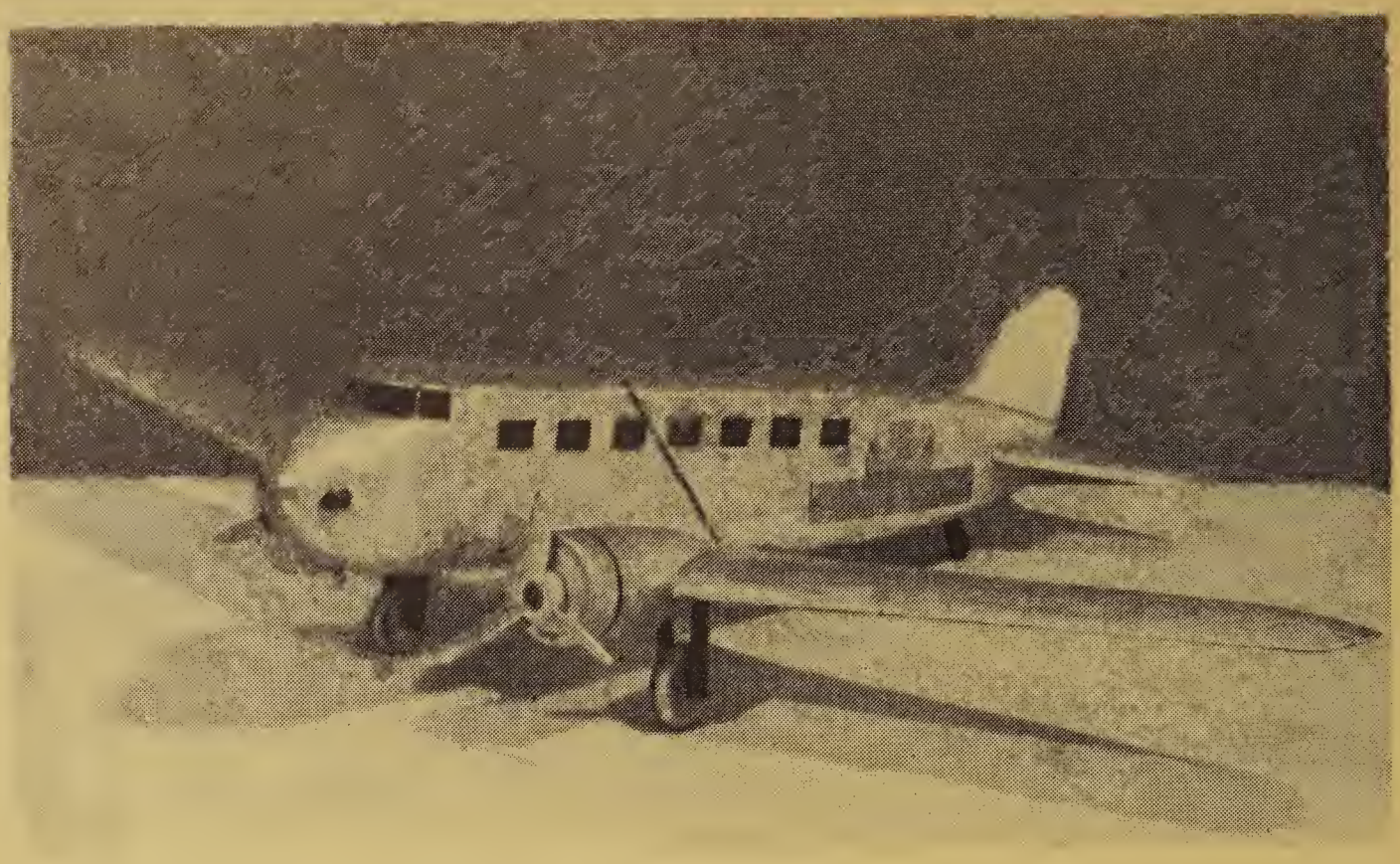
CHINA CLIPPER

Named after the New England clippers that carried the China trade in sailing boat days, are the China Clippers of the air lanes over the Pacific Ocean. They are huge, 26-ton planes, designed and built to meet every requirement of ocean travel. Their 90-foot hulls are divided into six watertight compartments, any two of which can keep the craft afloat. Four engines, each of 1,000 horse-power, equal to that of an ordinary locomotive, are mounted along the 130-foot wing-spread. About half of this 4,000 horsepower is constantly in reserve at all cruising speeds. The big, three-bladed propellers shift pitch automatically to insure the utmost efficiency.

On the flight deck is the bridge, where two pilot officers are on duty at all times. The radio officer is in constant touch with at least two ground stations, as well as with the ships on the sea below. Bearings are exchanged with radio direction-finding stations every few minutes. Farther aft, in his cabin near the edge of the wing and in line with the powerful engines, the engineering officer controls the mechanical operation of the giant ship. He maintains constant guard over the great power plants by means of 181 instruments, levers, and valves. On the main deck forward are the buffet, from which all meals aloft are served; the main cargo holds; and the air-conditioning apparatus. Regardless of outside weather, the atmosphere of the cabins is always healthfully temperate. Next aft is the navigation officer's cabin, in which are kept the remarkable instruments, including maps, compasses, and chronometer, by which the ship's course is plotted. Here, too, are the flying officers' berths.

Passing aft, one sees the sound-proofed, air-conditioned passenger cabins. First is the lounge, where as many as 15 passengers can be comfortably accommodated. The lounge itself is as large as a good-sized living room. Next to the lounge are two standard cabins, with berths for 12 sleeping passengers, and lounge chairs that accommodate 20 on the shorter flights between islands. Aft of these are the dressing rooms, and, farther aft, additional cargo holds and complete emergency equipment.

AIR TRANSPORTATION



DOUGLAS TRANSPORT PLANE

Length 26", Width 36", Height 7½"

DOUGLAS TRANSPORT PLANE

The Douglas DC-4 Transport Plane is one of the passenger airliners that has helped to bring about the Nation's network of airways and to establish recent safety records. Still a twentieth-century wonder, this type of plane is one of the attractions that draw millions of people to airports the country over to "see the big ships come in." Watching them swoop to earth and taxi to a landing, with giant propellers fluttering and motors roaring, is an exciting experience, even for the frequent airport visitor.

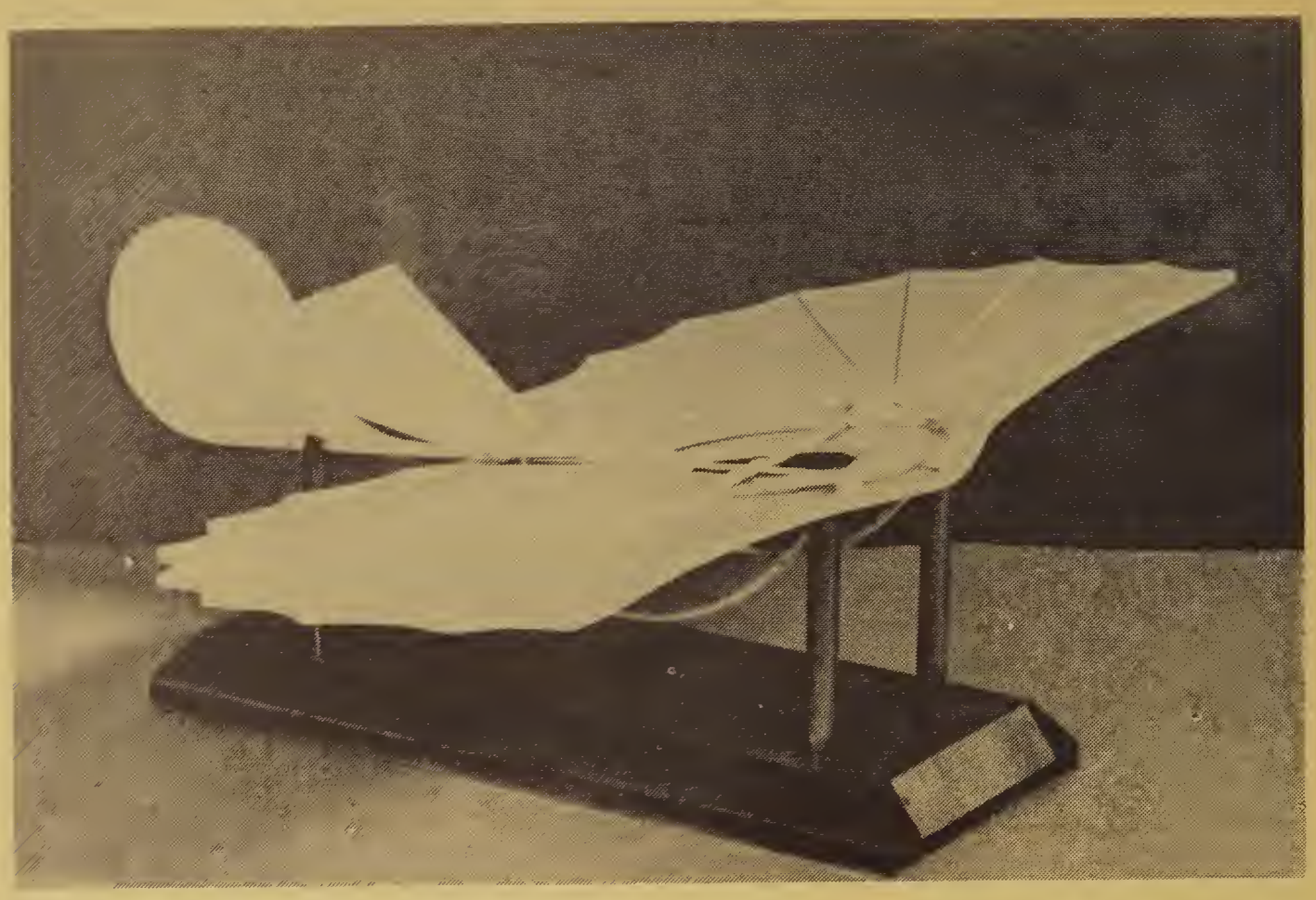
Close at hand, poised, waiting for a take-off, these huge man-made condors are impressive indeed. Encased in gleaming metal, the rotund fuselage of the plane rears above its extended retractable landing gear, gracefully lifting its nose 15 feet above the ground and slanting in diminishing proportions until it almost touches the ground at the tail, 40 feet away.

A cross-section of the plane body shows it built in circular form to provide stream-lined resistance to the wind and utmost strength per structural pound. A keel, or beam, in the bottom of the ship extends from tip to tip to strengthen it and supply maximum safety should the landing gear fail to function and a pancake landing be necessary. Entrance to the ship is through a door just past the mid-section. Wings are built into and from the fuselage, with wings and fuselage seemingly all one. Tail surfaces are cantilever and all metal.

The interior contains cargo and baggage holds, the lavatory, the cockpit, and the passenger compartment. In the cockpit sit the pilot and navigators who guide and control the ship. Engines are in the center of the wings, allowing plenty of clearance for the three-bladed propellers. The powerful motors can produce a speed of 240 miles an hour. Tanks in the wings can store 550 gallons of fuel gasoline. Landing gear is hydraulically retractable.

The main cabin contains two rows of chairs accommodating 16 passengers. Large oval windows provide good vision from each seat. The cabin is soundproofed, so that conversation may be carried on in a normal tone of voice. Indirect ventilation is provided, because direct ventilation would be impossible owing to the terrific wind velocity. Facilities are designed for comfort, though necessarily in cubicle proportions. Aft of the entrance door are the buffet and the stewardess' folding chair.

Flight instruments are contained in a central panel. The pilot's seat and the rudder pedals are adjustable. Flap gear is to the right of the pilot, and landing gear to the left of the co-pilot. The angle of the two-sectioned windshield eliminates glare. Constant improvement is being made in the huge, man-made birds, and today's planes will probably soon be outmoded by improved and larger models. But the wonder of man's flight in the clouds lies even in yesterday's air liner.



LILIENTHAL GLIDER

Length 24", Width 33½", Height 11½"

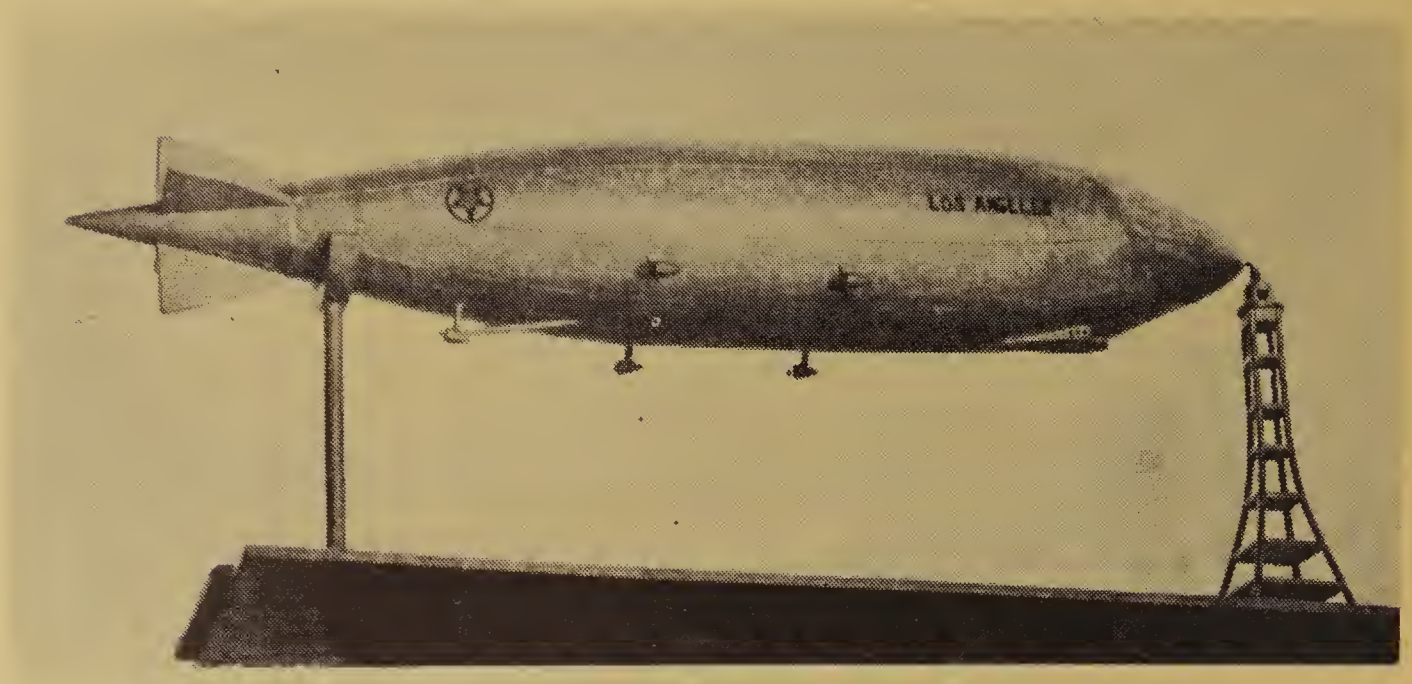
LILIENTHAL GLIDER

Man's ambition to fly like a bird is centuries old; it appears in transcriptions of legend — and is indicated even before. Consequently, it is not surprising to learn that the published record of Otto Lilienthal's glider experiments influenced and inspired the Wright brothers in their work with the powered airplane. Each trial contributed something new, and before the Wrights brought out the first practical powered plane they studied for years the previous discoveries and inventions. Without Lilienthal's research, the first flight of an airplane would have been delayed years; and, had he lived, he might have succeeded in flying the glider he was preparing to power with a $2\frac{1}{2}$-horsepower motor in 1896. Lilienthal's tragic death was not unexpected, for he had made thousands of flights in the flimsiest of craft — usually from the mountain slopes north of Berlin.

Lilienthal may be termed the father of aeronautical science, for he noted and recorded every effect of air currents and stresses on the wing surfaces of his gliders. These ships were made of cloth-covered wooden frames, through the center of which hung the legs and feet of the operator, free to assist in propelling or balancing the craft. The modern glider-sportsman has cables and machine controls to do all this.

A pupil of Lilienthal describes one of the flights made just before the inventor was killed when a wing gave way: "We carried it to the hill, and Lilienthal took his place in the frame, lifting the machine from the ground. He was dressed in flannel shirt and knickerbockers, the knees of which were thickly padded to lessen the shock of a too rapid descent, for he had learned to drop instantly to his knees after striking the ground. — He faced the wind and stood waiting. Presently the wind freshened —he took three rapid steps forward and instantly lifted from the ground, sailing off nearly horizontally from the mountain. He went overhead at a terrific pace, the wind playing a wild tune in the tense cordage of the machine. Suddenly he swerved to the left, and then came the forerunner of the disaster of the next Sunday (when Lilienthal was killed). It happened quickly. The apparatus tipped sideways as if a gust of wind had gotten under the left wing. For a moment I could see the top of the plane, and then he brought it to an even keel with a powerful kick of his feet and sailed away below me across the fields, kicking at the tops of haycocks as he passed them. When within a few feet of the ground he brought his legs forward and not withstanding its great velocity the machine stopped instantly, its front turning up, allowing the wind to strike under the wings and he dropped lightly to the ground."

AIR TRANSPORTATION



LOS ANGELES

Length 36", Width 8", Height 16"

LOS ANGELES

The rigid type of gas-filled airship known as a dirigible or zeppelin has vast potentialities, but, as yet, a poor endurance record, for its history is laden with disaster. The *Dixmude, Hindenburg, Roma, R-38, Akron, Macon,* and *Shenandoah* — these were all victims of squalls, crashes, and fires. Count Zeppelin, a German, was one of the earliest builders of this type of craft, achieving a successful flight in 1900. The main difference between the dirigible and its predecessor, the balloon, lies in the rigid framework and the cigar shape of a dirigible, which permit easy application of power and better control. For their lifting power, both depend upon a fabric body filled with gas.

The *Los Angeles,* turned over to this country as a war reparation payment in 1924, served actively for eight years, and was decomissioned in 1932 to ride out the rest of its days at the Lakehurst (New Jersey) Naval Station as an experimental and training ship. The 200-foot mooring mast is a four-legged, structural-steel tower set in concrete. On top of the tower there is a coupling, inside which rests the nose of the craft when the ship is at anchor.

Built in Friedrichshaven, Germany, the *Los Angeles* has been the longest-lived of all large dirigibles. Its framework is made of a light metal of great tensile strength, and the outer skin of balloon cloth is treated with a preparation of lead and a coating of aluminum paint to reflect the rays of the sun. Inside are 18 gas bags filled wtih helium, a non-inflammable gas, and the engines are in cars, or gondolas, that hang suspended beneath the hull. Fins, rudders, and elevators to guide the ship are attached at the rear. A long corridor, called the "cat walk," extends the length of the craft; it is so named because in earlier dirigibles it was merely a plank walk that one could negotiate only with the agility of a cat. Fuel tanks, ballast tanks, provision storage rooms, and crew and passenger living quarters are inside the mammoth bag. The galley, where meals are prepared, is entirely of aluminum. The *Los Angeles* has seen many parts of the world, sailing over land and sea in calm and stormy weather, participating in naval maneuvers, and serving as a school ship for hundreds of officers and men. It is either the most fortunate or the most sturdy ship ever constructed for it is the only one of many great dirigibles built in the last three decades that has survived.

OBSERVATION BALLOON

Length 23", Width 11", Height 17½"

OBSERVATION BALLOON

Although stratosphere and weather-recording balloons are really "observation balloons," the term is usually reserved for the bags of hydrogen or helium used in modern warfare to observe enemy movements. They are round or cigar-shaped and have earlike appendages on their sterns, to stabilize them in air currents. The bags are of varnished silk or rubberized cotton, the hundreds of strips of material being joined together by tape or rubber cement. A network of ropes cages the envelope and holds the observation car of woven basketwork in place underneath the balloon. The balloon is controlled from the ground, where it is fastened to a windlass (on a truck), which can reel in the cable rapidly and draw the balloon to the ground in case of an attack by enemy aircraft. A telephone line to the ground allows direction and correction of artillery fire as its effects are observed. In the event the "pull down" is not hurried enough, and enemy aircraft approach too close, observers may be forced to take to their parachutes or slide down the cables. An observation balloon can easily be set afire or shot full of holes by the machine-gun fire of attacking airplanes.

AIR TRANSPORTATION

SPIRIT OF ST. LOUIS

Length 23", Width 36", Height 9"

SPIRIT OF ST. LOUIS

Laboriously, the heavy-laden silver monoplane trundled down the runway. After a long run across the field, with its motor roaring mightily, the plane reluctantly began to slant skyward. Behind it, the late-afternoon sun colored the Pacific Ocean. Before sundown, the plane was over the Rocky Mountains; and midnight found it above the Middle West, droning a smooth rhythm of power. At dawn, the Atlantic coast was in sight. Other men and other planes had previously made similar flights, but Charles Lindbergh and the ship he later immortalized in *We* were about to set out for Paris, 3,610 miles across the Atlantic. This would be the first non-stop airplane flight across that ocean.

The *Spirit of St. Louis* was a Ryan monoplane, whose fuselage of duralumin measured more than 40 feet in wing-spread and 34 feet from nose to tail. It was powered by a nine-cylinder Wright Whirlwind engine of 223 horse-power. Cruising speed was 105 and maximum speed 125 miles an hour. Loaded, the plane carried 451 gallons of gasoline and 28 gallons of oil. The mottled silver shield, which gave the ship its distinctive appearance, hid an extra gasoline tank; and, because this obscured vision from the cabin, three tiny periscopes were installed to permit the pilot to see ahead.

Pilot Lindbergh soon had his ship ready to leave the ground again. Though it was a land plane, with no provision for alighting upon the water, no one seemed to worry. The quiet efficiency of the young man seemed to assure all who worked with him, and everything was very matter-of-fact. The motor was started and allowed to idle a while. Finally, apparently satisfied, the pilot shouted, "Let's go!," and the ground crew pulled the blocks away from the wheels, freeing the plane. The few spectators thought it was too heavy to leave the ground, but slowly it began to climb. Then it was almost out of sight, winging its lonely way over the watery wastes on that memorable May 20, 1927. When the feat was accomplished and the "Lone Eagle" landed at Le Bourget Flying Field in Paris, he received an ovation throughout the world.

AIR TRANSPORTATION

WRIGHT BROTHERS' AIRPLANE

Length 24", Width 36", Height 28"

WRIGHT BROTHERS' AIRPLANE

People called balloonists "balloonitics" and thought men had as much chance to fly as a "mud turtle to sprout wings," when the Wright brothers were experimenting with kites and other "fool contraptions." People said the boys would do better to tend to their bicycle-repair business at Dayton, Ohio. Few realized that, when Orville and Wilbur Wright made the first successful flight in a self-propelled craft at Kill Devil Hill, Kitty Hawk, North Carolina, on December 17, 1903, it would have world-wide significance.

The story of the Wrights is one of an unusual partnership that began in the similar interests of childhood. In 1896, when Orville was recovering from an attack of typhoid fever, he began reading the books of Otto Lilienthal, a German inventor who had just been killed in a glider accident. Intrigued, the brothers read avidly on the subject of flight. Then they turned to acquiring experience by building and flying kites. In 1899, they made their first glider flights at Kitty Hawk. For the next few years, they assimilated available theory and knowledge of gliders and bird flight. At this time, they found that a warped wing gave them greater lifting power. The control phase mastered, they turned to the question of power; for, if man was to fly, he must stay aloft long enough to learn to ride air currents.

Orville wrote, "Before leaving camp in 1902 we were already at work on a new machine which we proposed to propel with a motor." The automobile industry at Dayton aided the Wrights in building the four-cylinder, two-horsepower motor that was to accomplish the first flight. The model is a replica of this 1902 plane, on which the propellers were placed at the back to push the ship forward. There were two seats, but only one of the brothers rode at a time. The back rudder served only to stablize flight; steering was done from the front rudder.

On that bleak December day in 1903, only a few life guards and a strange man and boy were spectators. Wilbur's attempt failed. The two brothers warmed themselves. Orville clambered aboard, tested the motor, and let it idle a while. Then the wire holding the plane was released, and the ship sailed down the runway. Wilbur ran alongside, steadying the wing of the plane. At 40 feet, the ship began to rise, amid the jubilant shouts of the bystanders. It sailed away in the face of a 27-mile wind.

Orville wrote that the flight was exceedingly erratic because the control rudder was balanced too near the center, causing the ship to rise and fall suddenly. One of these darting motions ended the flight about 120 feet away. The flight lasted about 20 seconds, but for the first time in history a machine had raised itself in full flight and landed with some success.

COVERED WAGON

Length 36", Width 11", Height 17½"

COVERED WAGON

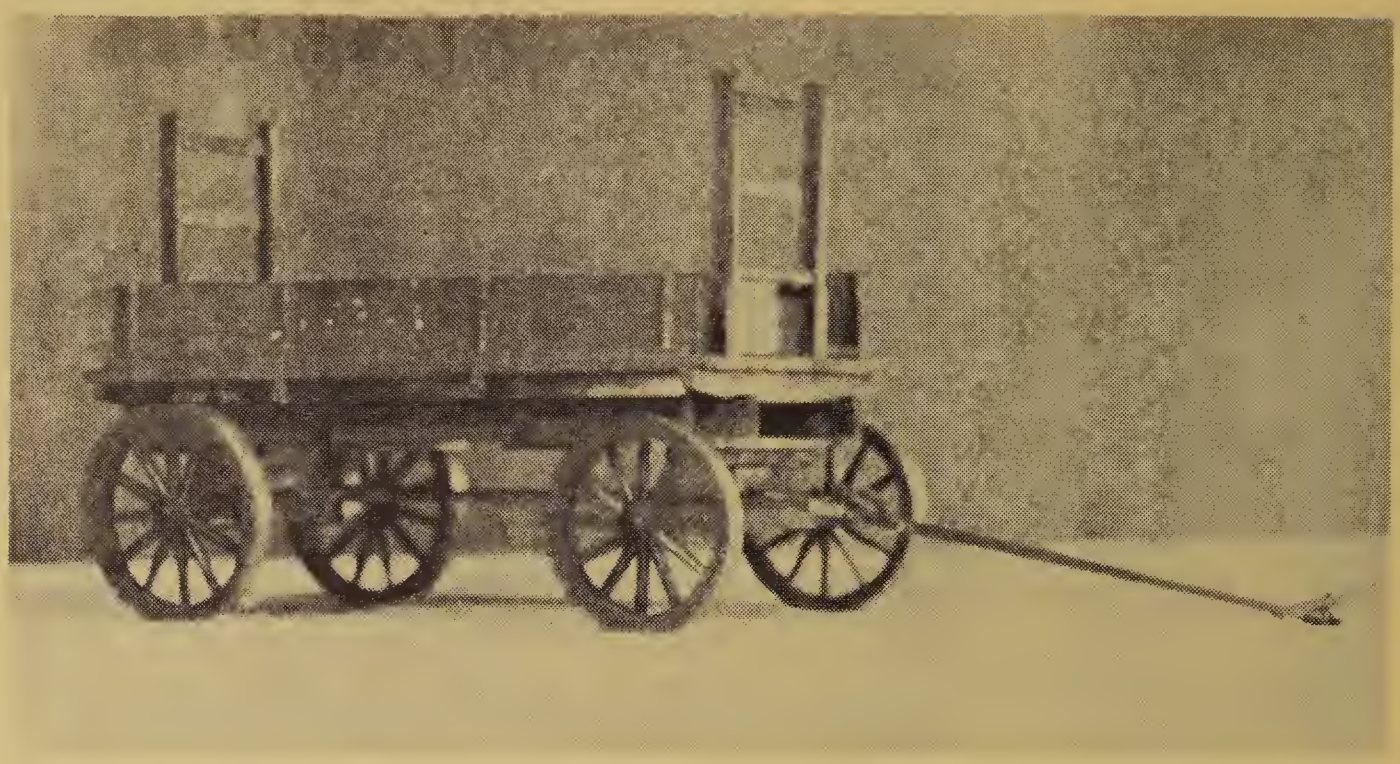
The covered wagon, often called the Conestoga, was the most familiar conveyance used in the settlement of the Old West — all the land from the Alleghenies to the Pacific Coast. It had a purely American origin, dating from the unsettled years following the Revolutionary War, when soldiers released from war duties turned westward in wagons like those used to transport ammunition during the war. The wagons were long, flat-bedded affairs, the high sides of which held willow poles, bent round in hoop fashion to support a canvas roof. The bed was built high to allow the large wheels plenty of room for turning. Tools and many household articles were hung in the space under the wagon. The wooden frame of the bed afforded steps for ascent to the driver's seat, which accommodated several people, and to the ample cradle of the tarpaulin-covered bed itself. Strong brakes and skillful maneuvering were needed to negotiate the mountains.

Conestoga wagons were not so awkward to handle as their lumbering and swaying would indicate. They were a decided improvement over the ox cart and other cumbersome vehicles of the period. They afforded constant shelter from sun and storm. Some of them were built so that the bed was in reality a boat when it was necessary to ford a stream. In extreme cases, the wheels might be removed and the horses swum across a particularly rough or deep river. The Ipswich-Marietta caravan started for the Ohio country in such a black-canvas-covered wagon in 1787.

On pleasant, moonlit nights, with lanterns swinging gaily and the occupants singing, a train of these wagons was a colorful spectacle. Drawn up in a circle about a big campfire, the train must have seemed a secure-enough home. Many were the adventures, however, that befell such trains, and countless the stories of courage pitted against the dangers in new country.

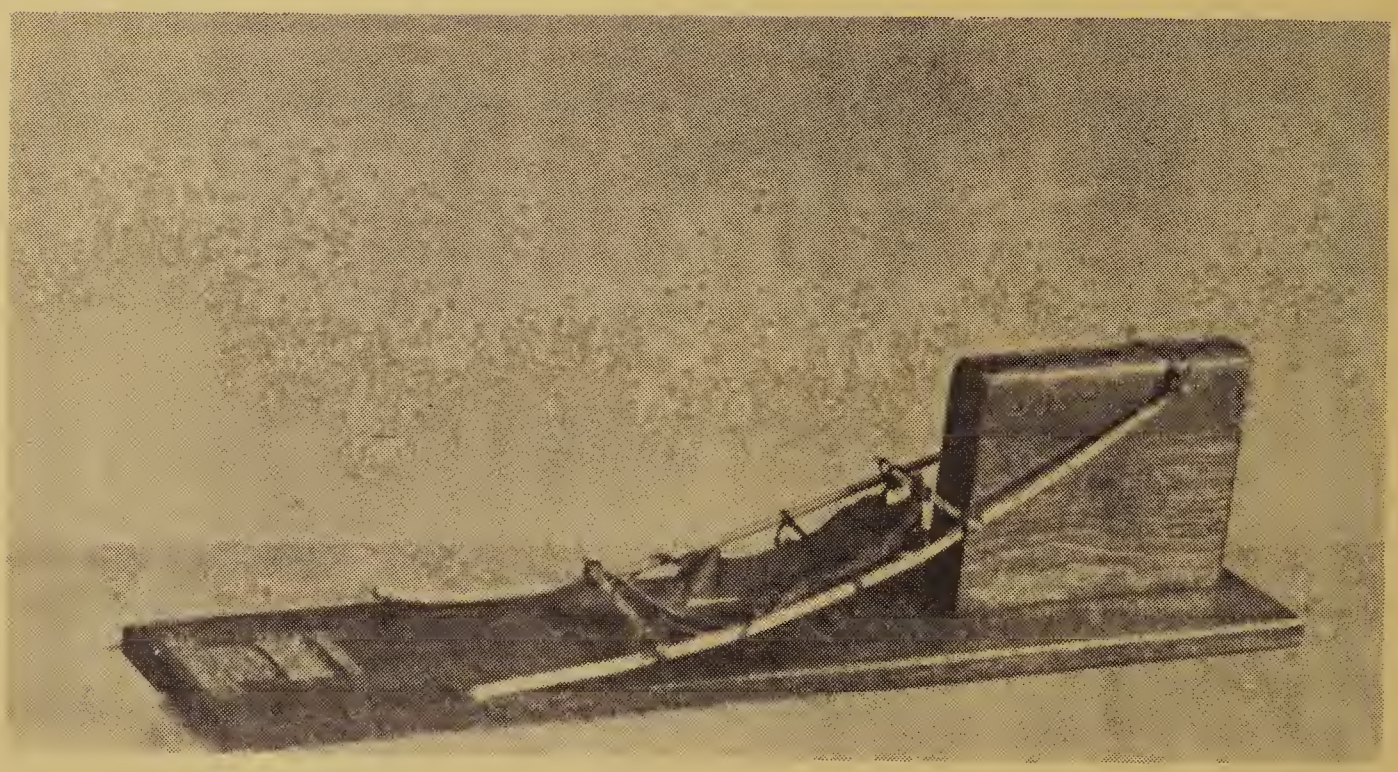
Horses, oxen, and occasionally mules hauled these "land ships," and were used to clear the land and till the soil when the settlers reached their destination. A great many settlers were educated and formerly wealthy people migrating because of political and economic considerations. In the Colorado State Historical Museum at Denver there is a small rosewood spinet, expensively made, that was found on the prairie, in the smouldering debris of a fire, by a band of settlers. Obviously, it was the loved possession of a well-educated wagon-migrant who, probably together with his family, was the victim of a murderous raid.

LAND TRANSPORTATION



FARM WAGON

Length 25", Width 7", Height 10"



INDIAN DRAG

Length 33 ', Width 7", Height 8½"

FARM WAGON

The spring wagon is an all-purpose carrier for general farm use. It is of light construction, and derives its name from the springs, made of leaves of steel bound together for greater strength. The bed of the wagon consists of closely fitted posts, individually removable when dumping loads of manure, gravel, or earth. In some parts of the country, the two rear wheels are made with wider steel tires for use on soft ground. The circumference of these wheels is usually greater than that of the two guiding front wheels. The front axle and wheels turn in the smallest possible space, while the rear axle is fixed rigidly to the wagon frame.

In most cases, the wagon is drawn by two large horses, called draft horses, harnessed one on each side of the wagon tongue. An easily removable steel pin holds the tongue in place, and imparts the necessary play that permits it to follow the sway of the walking horses. It is possible to use shafts and a fixed bed of planks in very light spring wagons. For ordinary hauling, such as that of loads of grain or small feed, side boards and an end gate allow higher stacking. When hay, sacked grain, fertilizer, or corn from the field are to be hauled, still higher side boards are fitted into place. For great logs or cut lumber, the whole bed of the wagon is taken off and the truck extended to suit the length of the logs, that are tied directly to the axles.

INDIAN DRAG

The North American Plains-Indian originated the drag, or travois, especially adapted for travel in the flat country he inhabited. In this vehicle, two poles were hitched to the back of a horse and allowed to drag on the ground. They were held together by cross-pieces. A hide was often lashed between the poles to make a kind of hammock suitable for carrying human beings or light loads. This was probably the first land vehicle in use in this country.

The drag had great faults. The platform for carrying goods was in a slanting position. Furthermore, the trail left was deep, and easy to follow for both Indian and white enemies. The drag was also limited as to speed and the amount of goods it could haul. Later, when these deficiencies became apparent, the dragging ends were raised and hitched to a second horse. Thus began the slow evolution of transportation facilities in this country, culminating in the machine-propelled contrivances of our time.

LAND TRANSPORTATION

JINRIKISHA

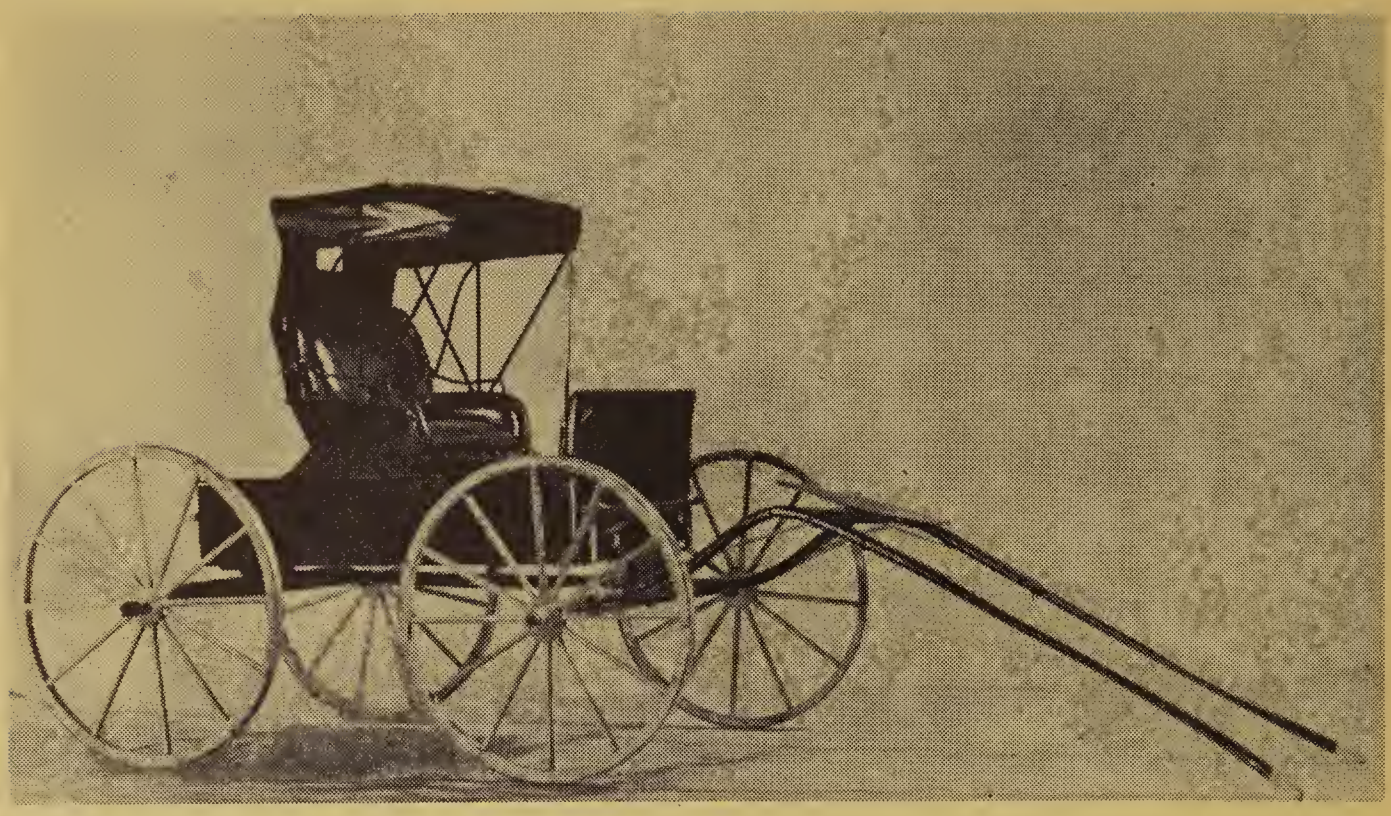
Length 12", Width 6", Height 9"

JINRIKISHA

Jin is Japanese for "man," *riki* for "power," and *sha* for "carriage." Thus we have in the word, *jinrikisha,* a good definition of this man-powered carriage so universally used in the Orient. Oddly enough, it was not invented by an Asiatic, but by an American Baptist missionary named Goble; it was first used extensively, however, in Japan. American adaptations of the jinrikisha include the wheeled chairs often used to trundle sightseers about the grounds of expositions.

The jinrikisha, or "rickshaw," as it is popularly called in English-speaking countries, is a light, two-wheeled carriage having a hood and shafts, between which the coolie runs, exerting his strength on a cross-bar. When more speed is desired, cords are attached, so that outrunners can aid in the task of pulling. With a swift coolie, one of these vehicles can attain a speed of eight miles an hour and cover as many as thirty to forty miles a day. Frequently, jinrikishas for hire are gaily decorated — perhaps to resemble a bird, a boat, or an animal — and the coolie, divested as he must be of all but necessary clothing, has a fancifully tattooed body. The hood of the model is shown partly brought forward from a collapsed position, in anticipation of a paying occupant.

LAND TRANSPORTATION



BUGGY

Length 28", Width 15½", Height 23"

NINETEENTH-CENTURY BUGGY

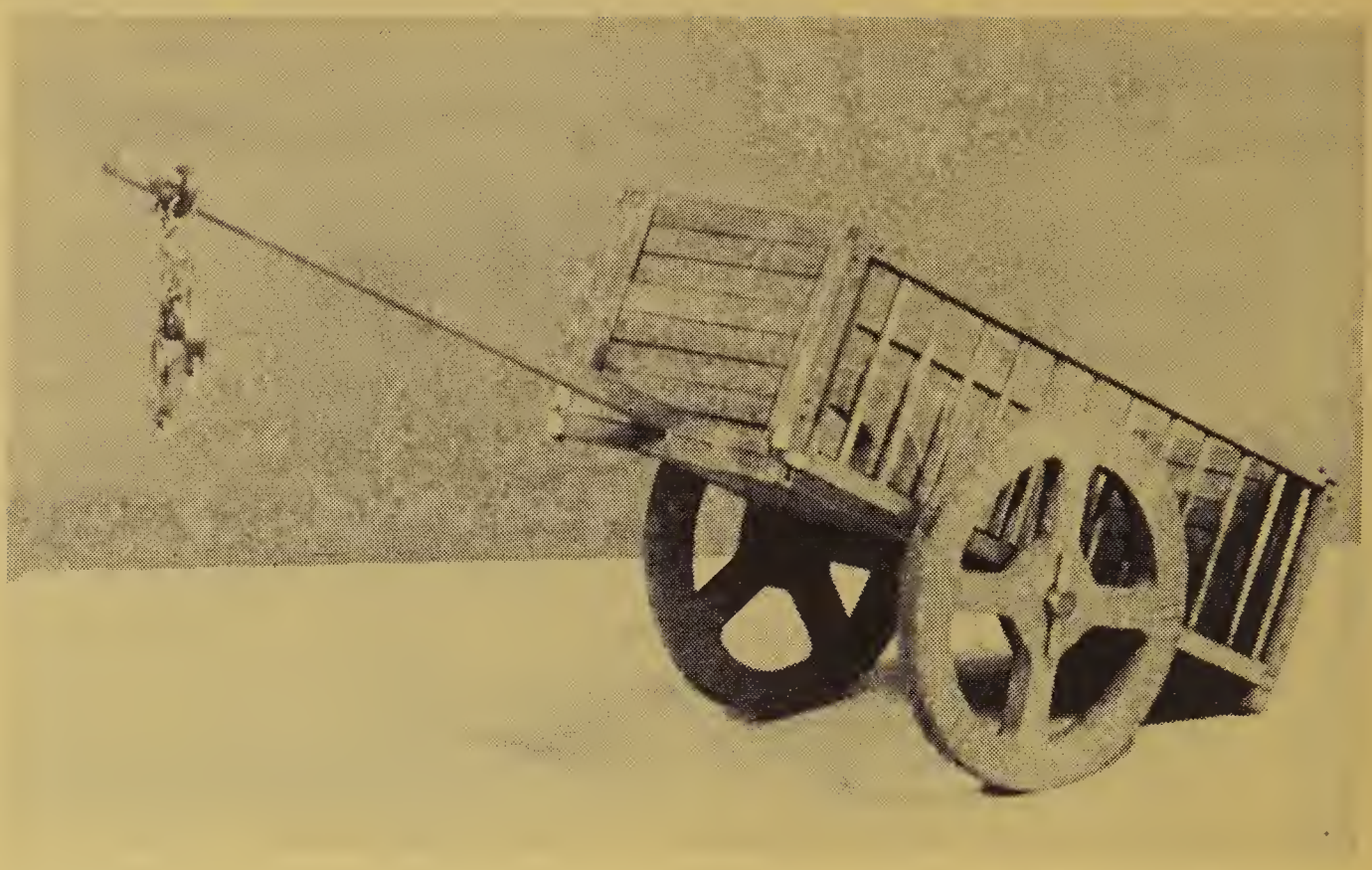
It is said that Richard Ewstead, a wheelwright in the Massachusetts colony in 1629, first devised the American buggy and coach, but the art of coach making advanced little in the next 150 years. For a long time, roads were quagmires of mud in winter and billowing clouds of dust in summer. Consequently, there was no demand for elegant vehicles. By 1830, however, an American by the name of Carter was making some outstanding contributions to the art of coach making. In contrast to the heavy English rigs, his buggies were lighter, stronger, and more stylish. He started a buggy-making tradition by using hickory wood instead of oak for wheels and other parts, and by making the springs elliptical, and parallel to the axle. Another new feature was the collapsible top.

The new buggy caught on; by 1850, plants throughout the country were manufacturing easy-rolling, light-framed buggies. The buggies were custom-made, and cost about $500 each. Coincident with rail expansion came mass production of buggies, bringing the prices within reach of the average man. James R. Huntington, of Amesburg, Massachusetts, a pioneer in this business, established his plant at Cincinnati. His first buggy sold for $32.

During the 1880's and 1890's, plants throughout the Middle West were turning out hundreds of thousands of the new buggies. For the first time, the great middle classes could own a horse and buggy, the badge of gentility. By 1880-90, the industry had reached its zenith; some 8,000 factories were employing 75,000 workers to produce 2,000,000 buggies annually. Such names as Durant, Fisher, Brewster, and Gardner were first associated with the making of buggies and carriages, and only later became famous in the automotive industry.

Shortly after the death of Queen Victoria in 1901, the buggy, hitherto the swiftest medium of personal transportation, acquired a new rival—the automobile. In very little time, the buggy fell into disuse, and garages took the place of livery stables and barns. In beauty and dash of style, a trimly outfitted horse and buggy compares favorably with the modern streamlined automobile.

LAND TRANSPORTATION



OX CART

Length 24", Width 7½", Height 9"

OX CART

Oxen and the ox cart were man's earliest means of transportation. They were used by Egyptians, Greeks, and Romans alike; even when this continent was settled, oxen beat the difficult trail westward. They had been used in the early South to haul plantation crops to water routes, in New England to get manufactured products to the clipper ships, and in the Middle West to carry corn, wheat, and farm produce to the canals. Oxen pulled the covered wagons of the first Ohio settlers, and the National Road was pushed over the Appalachians and through Ohio and Indiana with the help of the ox and cart.

Early roads in this country were uncertain and few. Even the strength of the horse was not sufficient to cope with frontier conditions. The massive build and stubborn endurance of oxen fitted them for the wilderness trails and the chores of homesteading. Horses were used for the quick transportation of human freight, but it was the ox that bore the real burden of breaking down the wilderness and preparing the way for improvements and civilization. Carts to haul grain to the mill, hay to the barn, and wood from the forest were often entirely home-made. Lacking a wheelwright, the farmer would fashion awkward, solid discs of wood for wheels. The bed of the cart was usually of wicker, though prosperity might allow a wooden one with an end gate. Wooden yokes held the oxen to the tongue of the cart; other harness was unnecessary. The driver directed the beasts on their slow, patient way by prodding them with a long pole he carried. In some isolated sections of the country, this form of transportation is still in use.

ROMAN CHARIOT

Length 15", Width 5", Height 7"

ROMAN CHARIOT

In ancient times, chariots were used in hunting wild game, fighting battles, racing and playing games in the stadiums, and even pleasure riding, (though it is hard for us to imagine what pleasure could be derived from riding) in these springless affairs over any but the softest dirt roads. Since their own countries offered such difficult terrain for chariot travel, it is generally thought that the Greeks and Romans imported the idea of chariots from lands to the east.

The common form of the ancient chariot was a car or body mounted over the axle of the two wheels and joined in front to the tongue or shaft, to which were hitched the horses. A protective apron of metal-sheathed wood rose between the occupants and the horses' hooves, and continued around each side as a protection from the wheels. The rear was left open except in some special chariots used for ceremonies and pleasure cars. Most chariots were of wood, ornamented and strengthened by metal. Fanciful and lavish decorations of ivory, bronze, iron, and precious stones and metal in intricate designs, high-lighted with brilliant colors of paint, made the most costly chariots wonderful to the pedestrian.

Early Assyrian chariots, which carried as many as six men into battle, were furnished with shields and quivers of arrows fixed to the chariot body; and they were drawn by three or more horses. Persian chariots often had knives, attached to the hubs, for use in battle. Curiously enough, the Britons copied this practice. Assyrian chariots, like those of the Egyptians and Persians, were drawn by only two horses, and were handsomely decorated. The wheels on Assyrian chariots were heavy, and had six to eight spokes. Greek chariots had four-spoked wheels and iron tires. The triumphal car of the Roman emperors was a circular-bodied chariot closed all around. In order to achieve greater speed, chariots used for stadium races and games were made lighter, but they were very dangerous to handle in enclosed spaces. About the time of Christ, chariots became obsolete with the introduction of several kinds of four-wheeled vehicles, fitted with seats and cushions and sometimes furnished with an awning or canopy.

SLEIGH

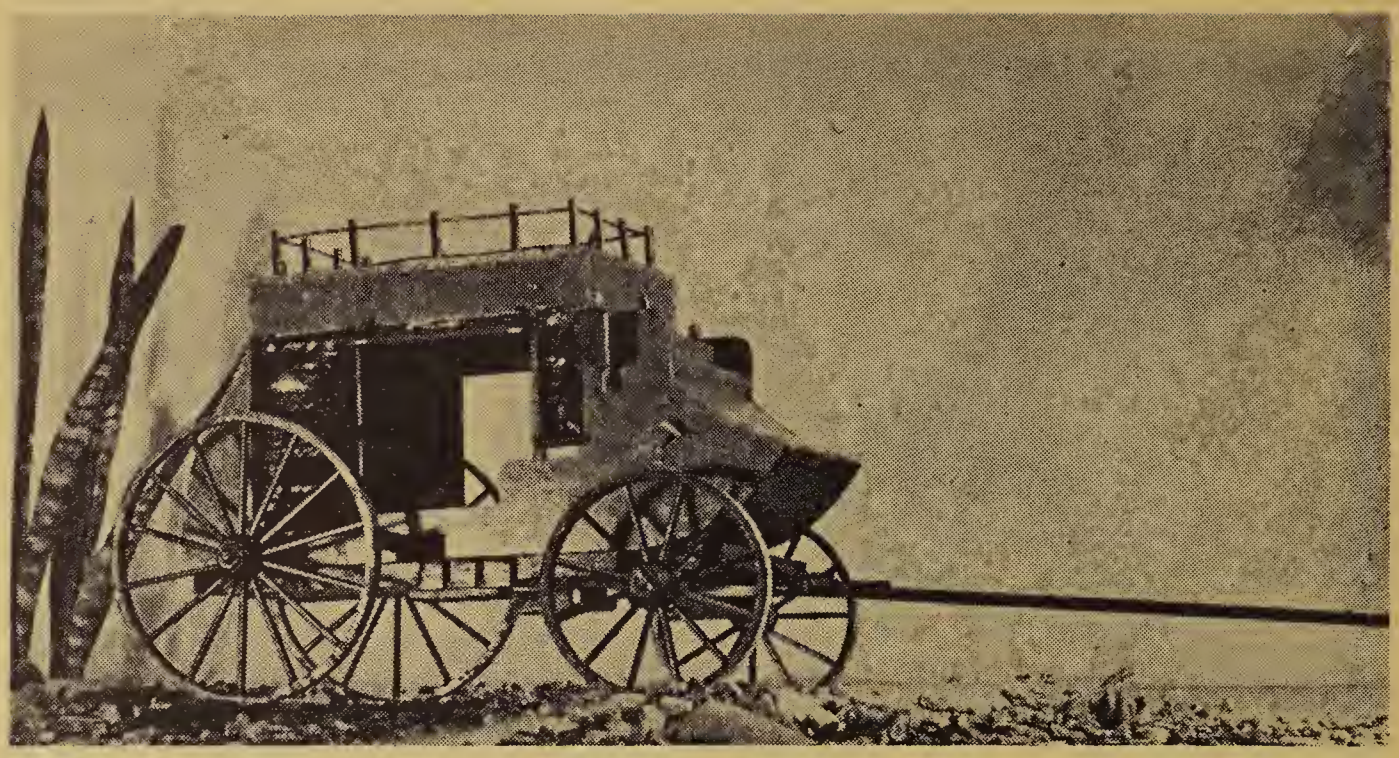
Length 29", Width 11", Height 18½"

SLEIGH

A sleigh is a carriage on runners used in traveling over snow and ice. Known in England as a sledge, this vehicle is very carefully and handsomely made where the winters offer good oportunity for its use. In Russia, it is known as a *troika;* the rich man's *troika* differs from that of the poor man only in the richness of its wood, metal work, and fittings of cushions and furs. Three horses are used to draw the *troika* — one hitched to the central shafts and the other two held by traces on each side and fastened to the collar of the middle horse by straps. Four reins are required to drive them. The sleigh of Holland assumes the shape of swans, dragons, sea shells, and the like; it is beautifully colored and gilded, and drawn by plume-bedecked horses. A Dutch adaptation of the sleigh is the sledge chair, in which a person seated in the chair-with-runners is pushed by a person on skates. In Lapland and the northern parts of Sweden and Norway, the sleigh is called a *pulka,* which is shaped like a boat and drawn by a single reindeer.

In the United States, a light sleigh drawn by one horse is called a cutter. Not so long ago, the handsomely decorated sleigh, aglide with sleigh bells jingling, was common in this country. In fact, before the World War, the street at the head of which stands the Ohio State School for the Blind was a favorite race course for cutters. Lowly cousin to the sleigh is the sled. The small hand-sled is used by children for play, the bob-sled carries coasting parties, and the farmer's sled hauls extra-heavy loads. North of this country, special dogs, bred for the purpose, pull the dog-sled.

LAND TRANSPORTATION



STAGE COACH

Length 36", Width 12", Height 7½"

STAGECOACH

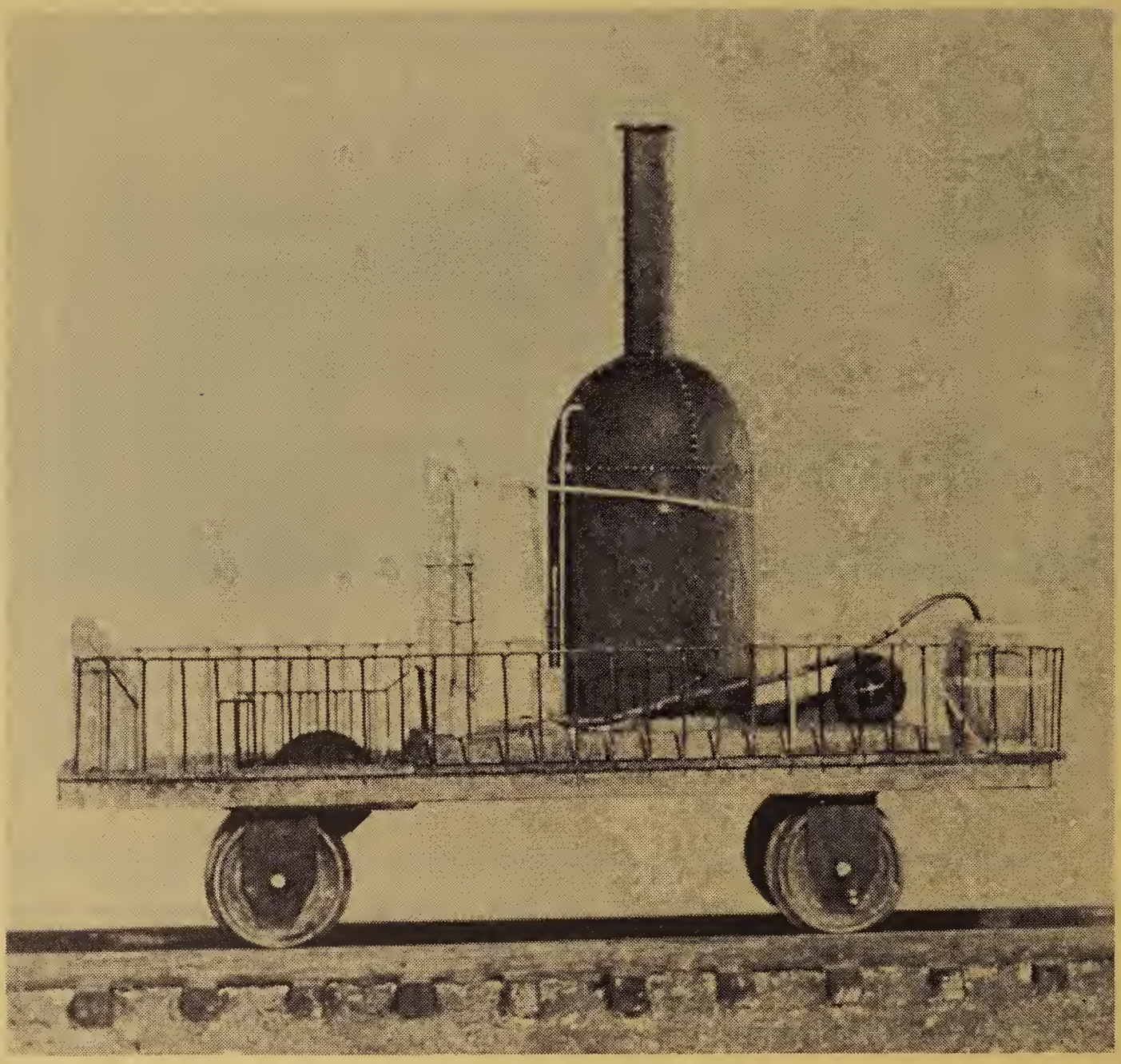
The stagecoach and the canal boat are symbols of a fascinating chapter in the annals of American transportation. Both met a definite need. The stagecoach provided speedy, dependable public transportation; the canal boat, cheap, sure routes to market for bulky products unmanageable in rough, muddy frontier country. Thus, invaluable aid was given in settling the western country and in encouraging commerce and communication between various sections of the Nation.

A typical stagecoach had room for six or more passengers facing each other on its large leather seats. Baggage was carried on the roof, where it was secured by iron guard rails and straps. The driver's seat was in front of the baggage, providing clear vision on all sides. Through dangerous country, an armed guard usually accompanied the driver, and, since most of the male passengers were also armed, the coach became a fortress on wheels in repelling attacks of Indians or outlaws. Heavy leather curtains protected the occupants from the weather, and often the coach was elegantly decorated and provided with comfortable appointments. Springs were made of heavy strap leather or crude, hand-forged iron. When wells were introduced for the wheels, sharp turns and accurate guiding became possible.

At best, coach travel was wearisome. Stops were made overnight at wayside inns, some of which became internationally known for their good food and entertainment. From the time settlers drifted across the Mississippi River, until the "iron horse" came upon the scene, all classes of travelers used the stages.

At one time, the Ohio Stage Company, with headquarters in Columbus, was the largest operator of coach lines in the Middle West. Most famous of all lines, however, was the Wells Fargo Company. Its coaches carried gold-rush adventurers to California in 1849, and it was the only link many a present-day western metropolis had with the outside world. This company also operated the first mail system in the West — the famed Pony Express, in which relays of fast-riding horsemen carried mails in record time through danger and rough weather. Sometimes a stage, bearing wounded occupants and the marks of an encounter with Indians or robbers on the trail, would careen madly into a town behind terrified, foam-speckled horses.

When railroads became the public carriers, stages were relegated to the stables, but some were later resurrected for exhibit purposes and for photoplay "westerns."



TOM THUMB LOCOMOTIVE

Length 14", Width 4", Height 10"

TOM THUMB LOCOMOTIVE

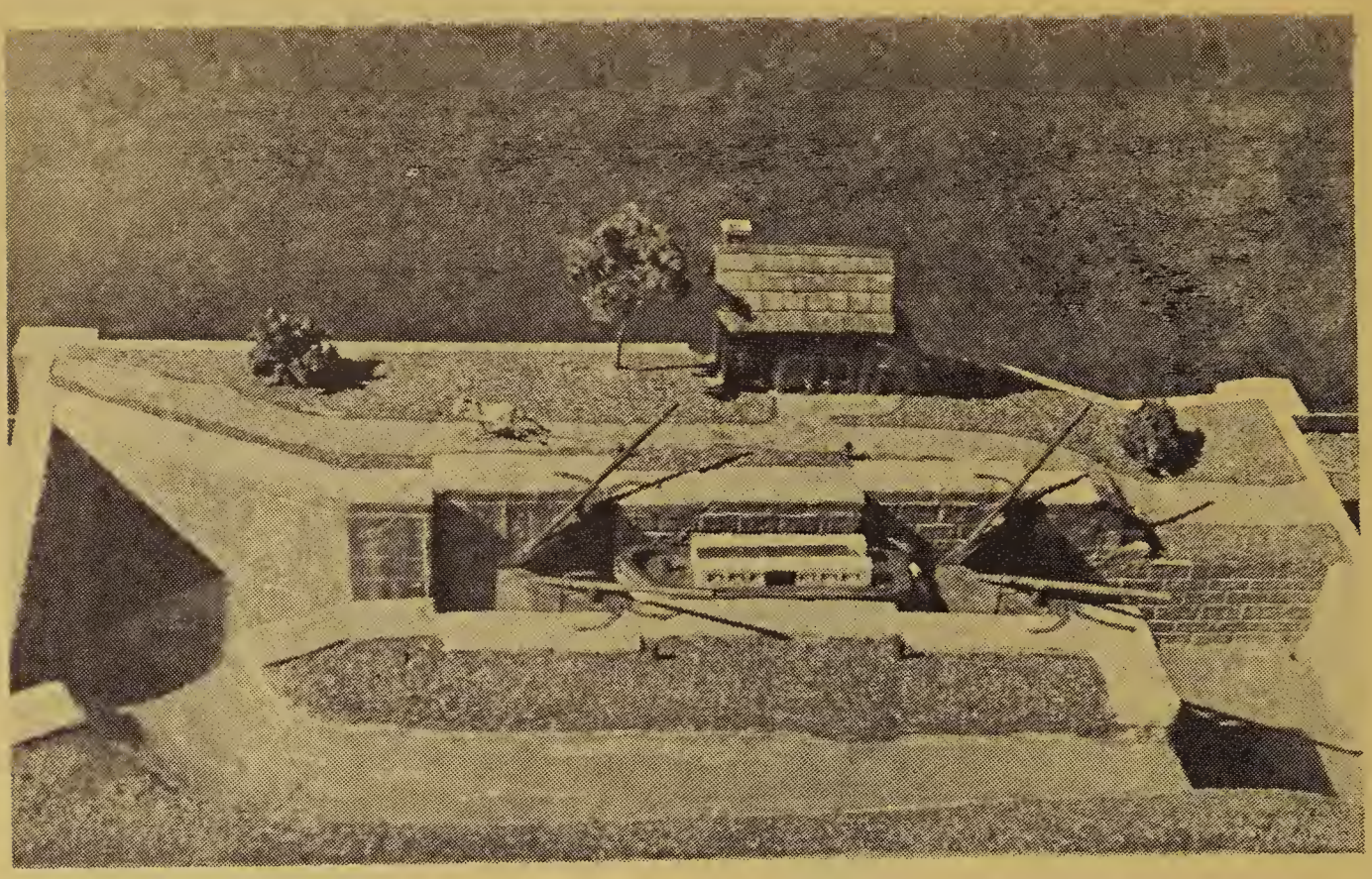
Two great means of transportation came in the United States during the 1820's and 1830's. The canals, principal pack-horses of American commerce until the Civil War, were begun, and the first locomotives puffed laboriously along a few short strips of rail in the East.

In 1827, two years after the completion of the Erie Canal, first of the important American canals, the Baltimore and Ohio Railroad, first in the United States, was chartered. It was an ambitious enterprise: rails were to be laid from Baltimore to the Ohio River! The arduous covered-wagon trek over the mountains, which seemed an insuperable barrier, would soon give way to a comparatively easy western passage by rail, and the railroad would regain for Baltimore the western commerce then diverted to the newly opened Erie Canal.

Motive power was still a question at this time. Experiments were made with horse-drawn trains, then with sail cars. In 1829, the search ended in England, where George Stephenson had contrived a steam engine that pulled a carload of people from Liverpool to Manchester.

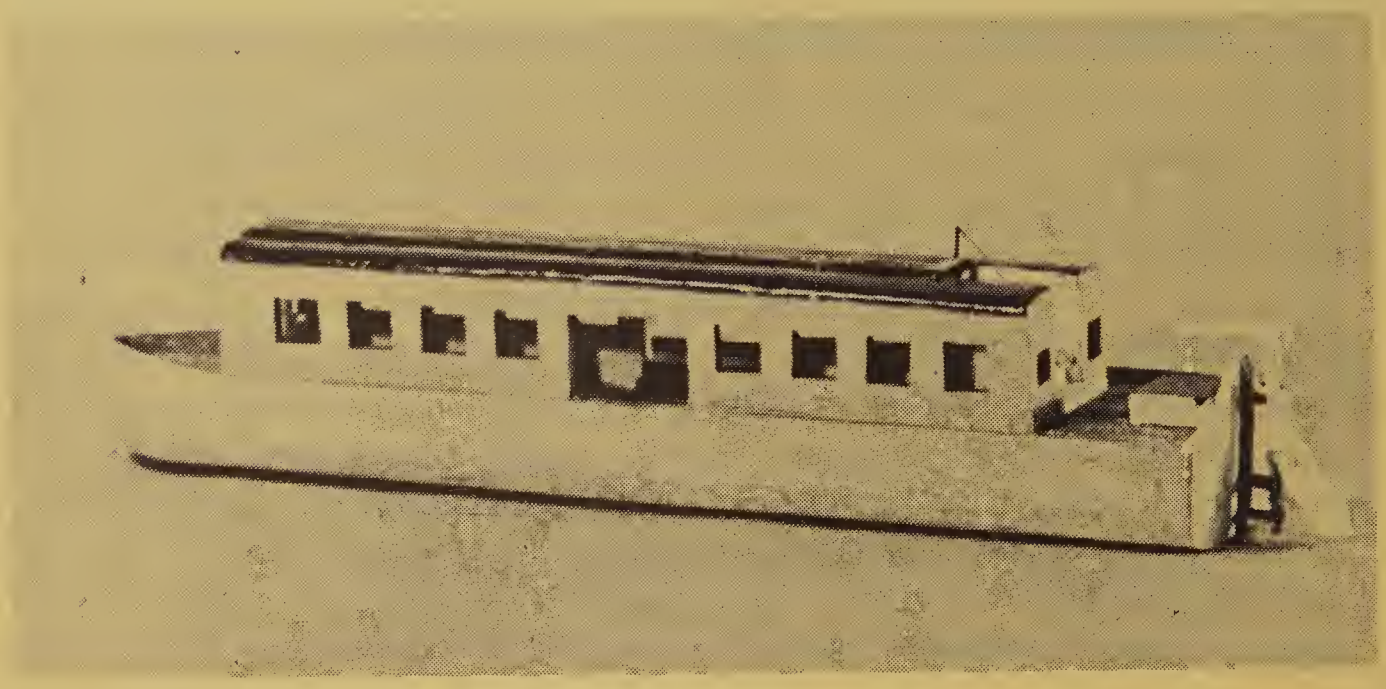
The next year, Peter Cooper, a wealthy New Yorker, built another version of the "iron horse" called the Tom Thumb. On the Baltimore and Ohio tracks, laid from Baltimore to Elliot Mills, a distance of 14 miles, the Tom Thumb achieved the then tremendous speed of 18 miles an hour. J. H. B. Latrobe, attorney for the Baltimore and Ohio Railroad during a half-century, thus described an early adventure of the Tom Thumb: "The triumph of this Tom Thumb engine was not altogether without difficulty. The great stage proprietors of the day were Stockton and Stokes; and on this day a gallant gray of beauty and power was driven by them from the town, attached to another car on the second track — for the company had begun by making two tracks . . . and met the engine at the Relay House on its way back. From this point it was determined to have a race home . . . At first the gray had the best of it . . . his steam could be applied on the instant, while the engine had to wait until the rotation of the wheels set the blower to work. The horse was perhaps a quarter of a mile ahead when the engine gaining speed, passed the horse and a great hurrah hailed the victory. But it was not repeated, for just at this time, when the gray's master was giving up, the belt which drove the blower slipped from the drum, the safety valve ceased to scream, and the engine for want of breath began to pant." The horse won, but not for long. Soon the "iron horse" was able to get up enough steam to turn its wheels faster and faster and leave the four-legged rival far behind.

WATER TRANSPORTATION



CANAL LOCKS

Length 48", Width 30", Height 6½"



CANAL BOAT

Length 20", Width 5", Height 4"

CANAL BOAT AND LOCKS

Transportation afforded many problems in the early 1800's. The steam engine was not yet fully developed, so that waterways and unimproved roads were the only avenues of travel. Since navigable rivers did not extend everywhere, and spring and winter mud made roads impassible, resourceful men conceived the idea of digging artificial waterways, called canals. The most famous of these was New York State's Erie Canal, completed in 1825. Soon, other sections, from Maine to Ohio, were excitedly building canals. In Ohio, two canals were dug to connect the Ohio River with Lake Erie.

There were two types of canal boats. The craft carrying such commodities as wheat, corn, and pork were flat-bottomed boats, similar to the earlier river flatboats. At first, they did not have a built-in roof, but one made of canvas, bowed over as in the covered wagons of the day. They were of wood, and built to carry as much as they could without sinking to the shallow bottom of the canal. Strong draft horses trudged beside the canal on a tow path and pulled the boats along by means of a tow rope.

But if the carrier boats sacrificed style for carrying capacity, as much could not be said for the passenger boats. These were called passenger packets, and in their lines and fittings they aspired to elegance. Extending almost their entire length, was a cabin, in the sides of which were windows from which passengers might glimpse the canal towns and the countryside. The roof of the cabin, also, was used as a sightseeing deck. Cabin interiors often were fitted as richly as their gayly painted exterior might indicate; some packet lines advertised their boats as "palace boats."

Since canal travel moves in both directions, a canal is almost totally devoid of current. This lack of current necessitates some method to lift or lower boats to varying land levels. Thus, canal locks are used; these are enclosures that can be flooded or emptied of water after their two gates are closed. When a boat comes to a part of the canal where the level is higher, the lock gate is closed behind it. Then the enclosure is flooded, lifting the boat to the higher water level. The forward gate is then opened, and the boat can continue. This procedure is reversed for travel the other way.

The captain of the freight packet differed from the captain of the passenger boat. The freight captain was usually a burly, profane type given to lusty singing of canal chanteys; while the passenger skippers disported themselves like "gentlemen dressed for the part," and, more often than not, could play a musical instrument for the entertainment of passengers. The "captain's horn," blown to announce the arrival of a packet in port, added to the gala atmosphere of canal travel. When the railroad and other factors caused a gradual abandonment of the canals, many people sighed at the passing of a romantic means of transportation.

FLAT BOTTOM BOAT

Length 35", Width 12", Height 10"

FLAT-BOTTOMED RIVER BOAT

Before the steamboat and railroad were made practical, there was much travel on American waterways, particularly the rivers. In this pioneer period, rivers and streams were the only practicable routes to main markets, especially in the Ohio Valley.

In the early 1800's, the broad Ohio was often speckled with craft bound downstream, usually headed for New Orleans, and heavily laden with grains, pork, turkeys, hides, and other miscellaneous products. Every tributary stream contributed to this river traffic. Spring, however, was its great season. Spring freshets provided sufficient draft for even the shallowest creeks and rivers to float heavily laden flat-bottomed river boats.

These were a primitive, awkward craft, designed not so much with an eye to appearance as utility. Flat-bottomed and made entirely of wood, they were chiefly designed to have as capacious a hold as possible. They were rectangular in shape and broad of beam, often being called "broad horns." They were guided at the stern by a steersman, who fended the awkward craft from shoals and obstruction; frequently, his steering oar was as long as the boat. Crew members also were provided with long poles to assist in navigating perilous waters.

Usually, the boats were 7 feet deep, 16 wide, and 60 to 70 long. Sometimes, however, they were as long as 100 feet and as wide as 18; these larger craft could contain a cargo of several hundred thousand pounds. Boat bottoms were usually caulked with tow, and occasionally painted with tar. Over part, or all, of their length were bowed canvas tops, similar to those of the covered wagon.

The boats traveled as fast as the current would carry them, and, in the spring, when the freshets made the rivers swollen and swift, this was fast enough, considering that the craft were not easily maneuverable and that each stream debouched scores of craft to the mother river.

The most usual feature of the flat-bottomed river boats was that they were usually built only to make the down-stream trip. Their timbers constituted part of their cargoes, since at New Orleans the boats were dismantled and sold as lumber. This was done chiefly because taking a flat-bottomed river boat up stream was a task beyond the ability of the scant crew, generally of two to eight members. The crew made its way home afoot or on mounts bought in the South.

By 1855, advent of the steamboat and railroad had ended the lusty day of the flat-bottomed river boat, a romantic chapter of American river life.

MAYFLOWER

Length 15½", Width 6½", Height 16½"

THE MAYFLOWER

The *Mayflower* is the most famous sailing vessel in American history. From its modest deck stepped the first settlers of the American colonies.

A large, heavy vessel of its day, of 180 tons burden, the *Mayflower* had been both an English merchant vessel and "man of war," and carried eight or ten guns. A companion vessel, the *Speedwell,* had been bought by the Pilgrims at Delthaven Holland, and then sailed in July, 1620, to join the *Mayflower* at Southhampton, England, where the actual crossing of the Atlantic was to begin.

The Pilgrims who were to make the first journey of settlement to the new world were a stubbornly devout people. As Separatists, they had believed that the English church and state should be independent of each other, and that man should be allowed freedom of worship. When their beliefs subjected them to persecution, they fled, in 1608, to exile in Holland. One of the vessels they procured was the Dutch ship, *Speedwell,* and the first part of the journey was actually begun from Holland.

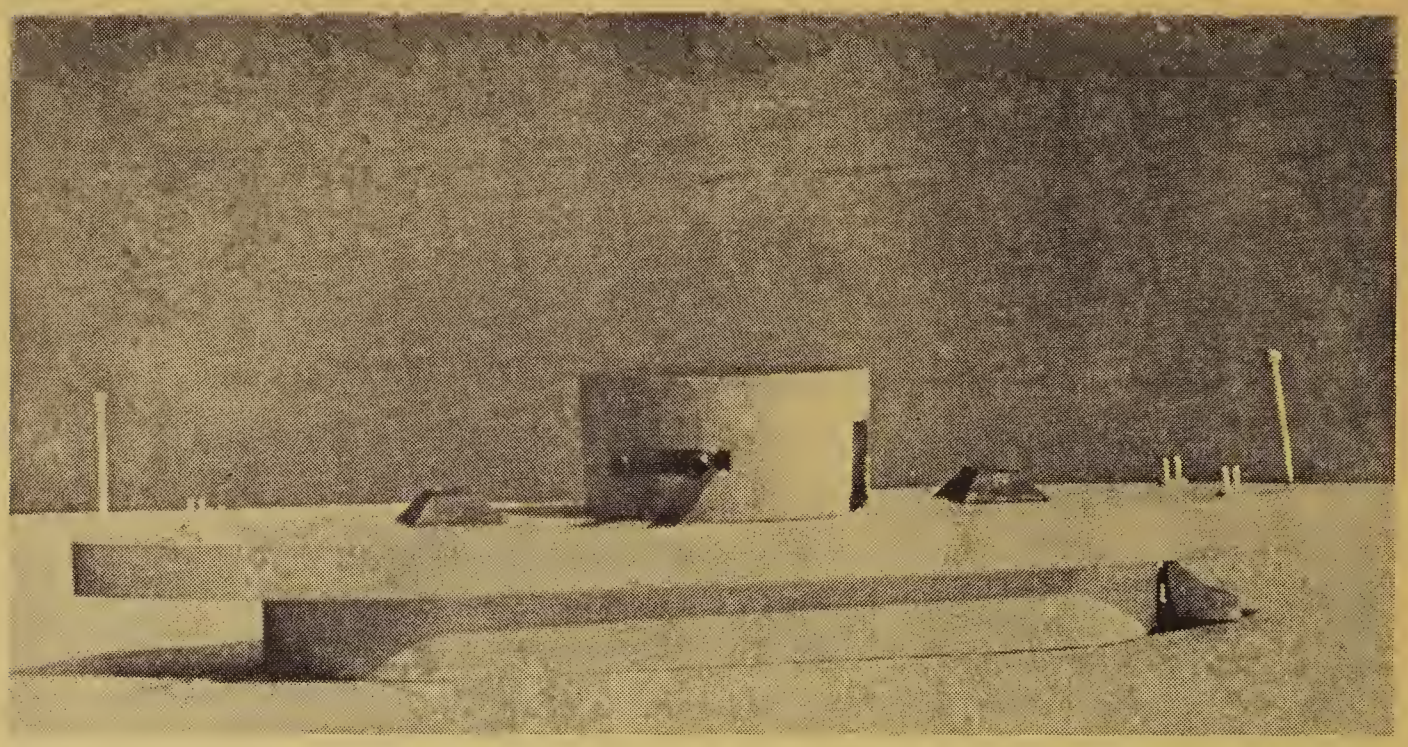
Amid the exciting tumult of leavetaking for a strange, distant land, the *Mayflower* and *Speedwell,* carrying 90 and 30 passengers respectively, set sail on August 21, 1620. At sea, the small, 60-ton *Speedwell* sprung a leak, and it was decided to return and overhaul the ship. Again the two ships' sails were set to westerly winds, and again the unseaworthy qualities of the *Speedwell* required a putting back to port, this time to Plymouth, England. There it was decided that the *Mayflower* would make the journey alone. On September 6, 1620, the *Mayflower's* sails were set to catch the winds that would bring it to America. Crowded aboard were 101 passengers.

The voyage had all the elements of drama: a man washed overboard as the ship was pounded wildly by waves and winds; a death through natural causes; a birth; and finally the great moment of sighting land.

The *Mayflower* hove in sight of land on November 8, and put down anchor in Cape Cod Bay (now Provincetown Harbor) soon afterward. Here the Pilgrims signed the famous Mayflower Compact on November 11. Although the Pilgrims were simple, humble folk, multitudinous descendants, several hundred years later, would take fashionable pride in telling of the coming of their forebears on the *Mayflower;* and in some New England cities a place in the social register would be an acknowledgment of this distinction.

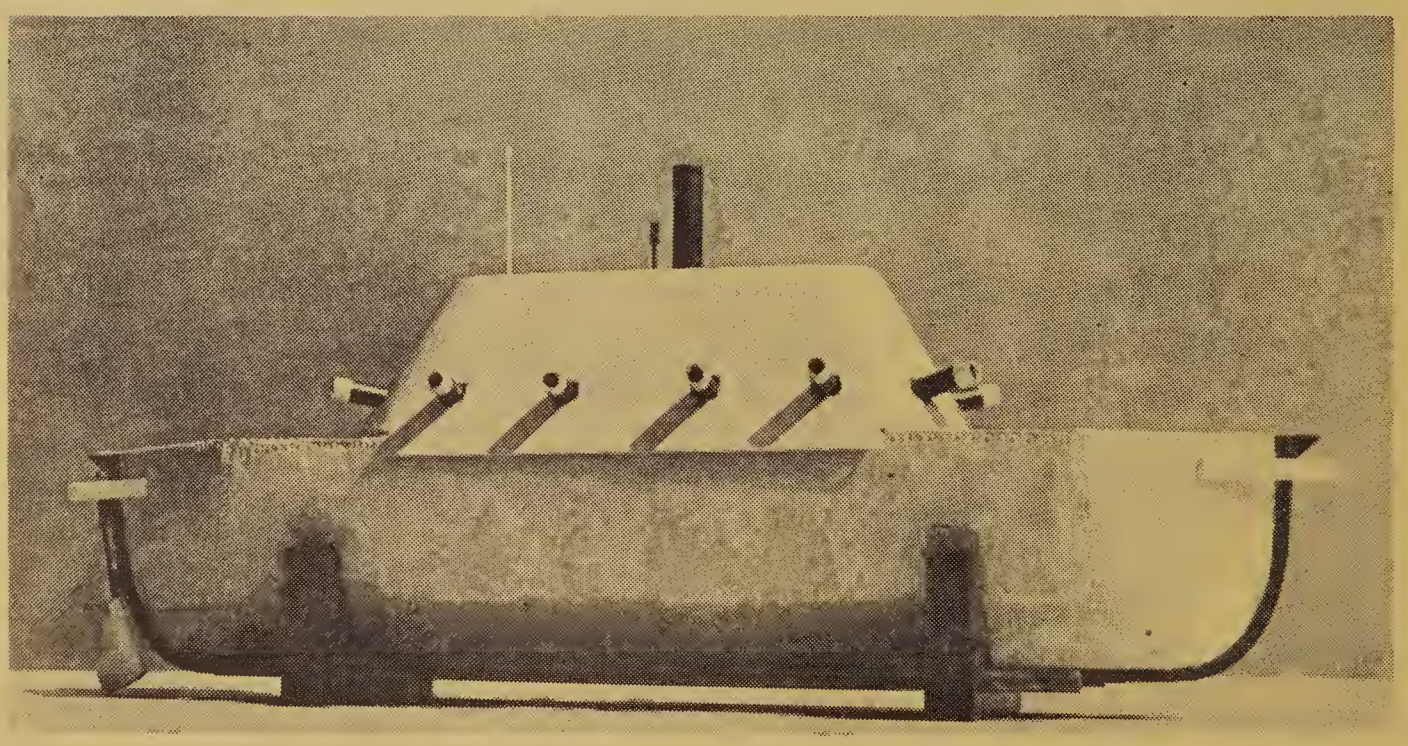
Although an exploratory party of 16 men, headed by Captain John Smith, set foot ashore soon afterwards, it was not until December 21 that a permanent place of landing was made at Plymouth Harbor, and the voyage of the *Mayflower* was at an end.

WATER TRANSPORTATION



MONITOR

Length 14½", Width 3½", Height 3½"



MERRIMAC

Length 23", Width 6", Height 8½"

MONITOR AND MERRIMAC

Although the story of the *Monitor* and the *Merrimac* is in the history of the American Civil War, this first encounter between two ironclad ships had world-wide significance. In the summer of 1861, Northern spies informed Washington officials that the Confederates had lifted the sunken Federal ship, *Merrimac,* from the bottom of the Elizabeth River, where it had been scuttled, and were rebuilding it in a startling form. The wooden ship first had been cut down to its water line; then a sloping structure of iron plates, four inches thick, had been erected over its hull. Aft of the ship, there was built an iron pilot house, barely a yard high. From the sides of the sloping main structure jutted 10 cannons; while a powerful iron ram was added to the ship's prow.

News of this sea monster stirred the North to great activity. The *Monitor,* an iron-clad ship of even more unusual design than the *Merrimac,* was begun at Greenpoint, Long Island. When it was completed, people averred the vessel resembled nothing so much as a "cheesebox on a raft." The deck, so low that water easily rolled over it, was 172 feet long and 42 wide. In its center was a revolving circular turret, 20 feet in diameter and 9 feet high, with iron sides 8 inches thick. From the revolving turret, two powerful cannon could pour fire in all directions.

The completed *Monitor* awaited the call to battle. On March 6, word came that the *Merrimac* was on the move. On March 8, before the *Monitor* arrived, the *Merrimac* had a successful battle off Newport News. It rammed the Union's wooden frigate, *Cumberland,* grounded the *Congress,* and awaited only the return of daylight to destroy the entrapped *Minnesota.*

But at dawn, instead of finding an easy prey to ram, or pound to pieces with its guns, the *Merrimac* discovered a new and powerful adversary. Not far off lay the *Monitor,* which had steamed up during the night.

At 9 a. m., the battle began. After slowly approaching each other, like two great, cautious beasts, the ships began to pour shot point-blank. At 11 o'clock, the *Monitor* withdrew to replenish its ammunition. Despite the exchange of damaging fire, the sides of neither ship had been pierced.

A half-hour later, the battle was resumed. Each ship scoured the other with cannonball and shot, furiously striving to find a vulnerable spot. Finally, the *Merrimac* began firing at the *Monitor's* pilot house, where a lucky shot through a sight-hole blinded the commanding officer. At this point, although neither ship was materially damaged, the battle ended. The *Monitor* withdrew, as did the *Merrimac* shortly. They were never to meet again.

Both ships had a sorry end. When the South evacuated Norfolk on May 9, the *Merrimac* was scuttled. On the last day of the year, a mighty gale off Cape Hatteras sank the *Monitor.* In their brief history, these two ironclads had opened a new naval era, featuring the armored warship.

QUEEN MARY

Length 46", Width 6", Height 11"

OCEAN LINER

The steamship, *Queen Mary,* of the Cunard White Star Line, a British company, has great size, beauty, and comfort. Moreover, it holds the world's record for speed in both east and west Atlantic crossings, averaging 30.63 knots an hour in 1936. It is the longest ship at waterline, measuring 1,004 feet. The tonnage — 81,235 gross and 76,390 displacement — is larger than that of any other ship in the world. The engines, operating under about 200,000 horsepower, are the most powerful ever developed in an ocean liner. The largest room ever built into a ship is the main dining room of the *Queen Mary;* it is 160 feet long and 118 wide, and extends through three decks, allowing seating for the entire cabin class at one time.

Over-all length of this giant of the seas is 1,019.5 feet, greatest breadth 118 feet, and height from keel to masthead 234 feet. Of the ship's 12 decks, the 750-foot-long promenade deck presents the most amazing succession of facilities. Aft on this deck is the smoking room; other rooms include a ballroom, library, writing and lounge rooms, drawing rooms, lecture room, children's play room, and a remarkable observation cocktail lounge, which is forward under the bridge, commanding an unobstructed view ahead. On 9 decks, served by 21 elevators, there are 25 of these public rooms. To complement the cocktail lounge, the verandah grill is placed aft; from it, there is a perfect outlook above the receding wake of the ship. Total deck space for outdoor recreation amounts to about twice the area of an American football field — 112,000 square feet.

Three funnels carry off the fumes of the 24 enormous boilers, heated by the 200 oil burners necessary to generate steam for the turbines, which contain 257,000 hand-fitted blades,

There are 421 cabin-class suites and rooms, 300 tourist-class staterooms, and 214 third-class rooms, accommodating, in all, 1,995 passengers. The transmitting and receiving equipment of the wireless and radio is more powerful than that on any other vessel. Ship-to-shore telephone service is available from public booths or bedside telephones. Thirty-eight loudspeakers distribute radio programs of Europe and the Americas. There are two complete sets of steering controls and the latest Sperry Gyro-Pilot. Officers on the open bridge, protected by a screen of air thrown up over a curved coping, can see fore and aft at all times from 12-foot projections at each side.

SCHOONER YACHT

Length 12", Width 3½", Height 17"

SCHOONER YACHT

The schooner is a ship propelled by sails with two or more masts, while the yacht is a pleasure craft. Therefore, a schooner yacht is a schooner that is sailed for pleasure.

Since the schooner yacht is a speedy craft, the famous international sail-yacht races often have a majority of schooners as entrants. In fact, the schooner evolved from the efforts of American ship builders to make sail ships of greater speed. Legend has it that the first schooner was built by Captain Andrew Robinson at Gloucester, Massachusetts, in 1713. It is said that, on the occasion of the ship's first trial, a large crowd gathered to witness its performance, and, when the wind caught the fresh sails and the ship began to glide out, an admiring bystander exclaimed: "Oh, how she scoons!" Robinson, according to this story, chorused joyously, "A scooner let her be!"

Other ship builders began to make schooners, and soon these craft were sailing the world with passengers and merchandise. When the steamboat came, the schooner did not disappear, but, in smaller form, began to be used as a pleasure and racing craft.

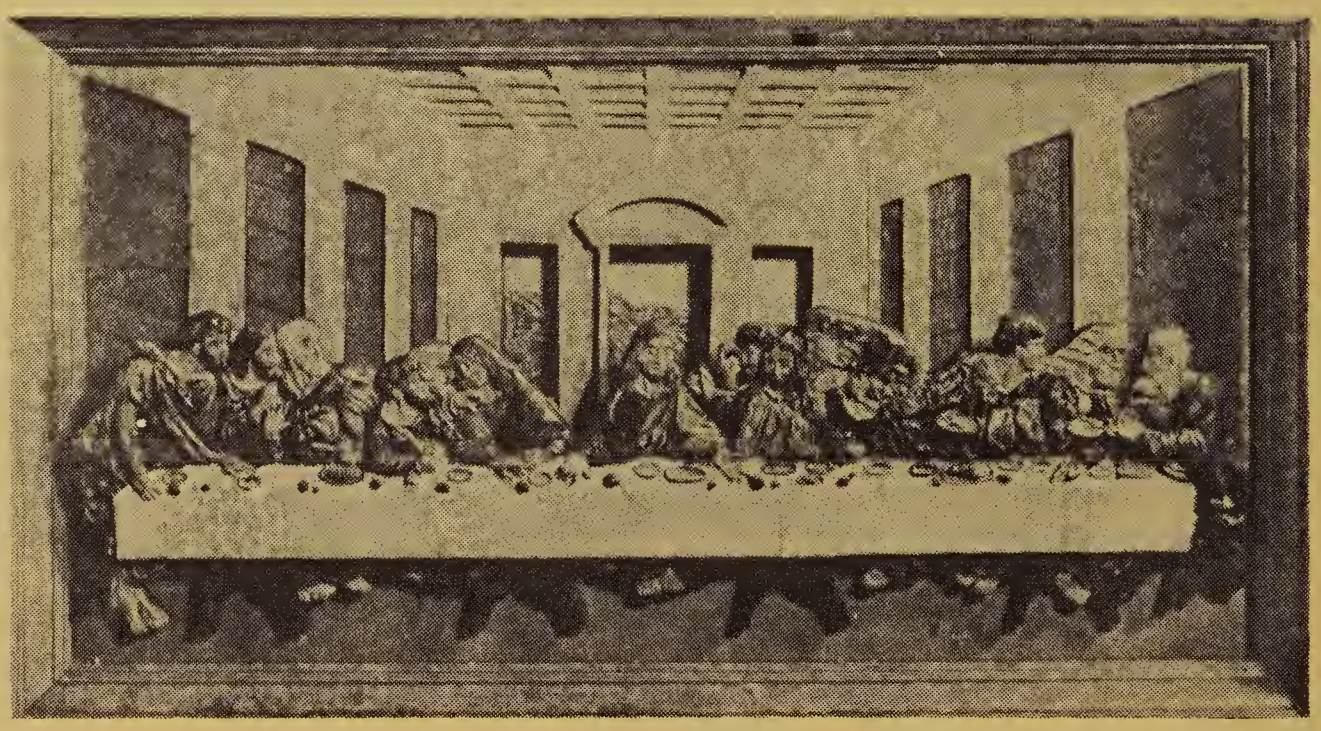
Although the racing of sail ships first began in the eighteenth century (in the waters surrounding the British Isles), it was not until the early 1800's that the practice became a recognized sport. The schooner, which measures 40 to 125 feet, was found ideally suited for "catching the wind and just sailing along" or matching speed with another craft. In 1851, when the first race for the trophy later called the "American Cup" (a cup first given by the British) was sailed off Cowes, England, 7 of the 15 competing vessels were schooners, and the remainder one-masted cutters. The schooner, *America,* won the race. Since then, the American Cup races, run at irregular intervals, have been among the world's great sport events.

In 1866, the first transatlantic race was won by the *Henrietta,* which defeated two other American schooners. The winning time was 4 hours less than 14 days. The greatest ocean race was run in 1905; the 11 contesting ships represented the United States, Great Britain, and Germany. The winner, the three-masted American schooner *Atlantic,* traversed the 3,013 miles from Sandy Hook, New Jersey, to Land's End, England, in 12 days, 4 hours.

The model, a replica of a two-masted schooner yacht, includes such small details as the movable hatch door.

NIGHT OF THE FIRST CHRISTMAS

Length 19½", Width 25", Height 14½"



THE LAST SUPPER

Width 31½", Height 17"

THE NIGHT OF THE FIRST CHRISTMAS

The Bible describes the birth of Christ simply and eloquently in a passage perhaps better known than any other in world literature.

Modern man, too, has attempted to describe this memorable event. The canvas, "The Night of the First Christmas," by Louis Maurice Pierrey, is one of the best descriptions in paint. It depicts the worship of the newly born Christ child by the four shepherds, who stand with their two dogs at the stable entrance. Within lies the tiny Jesus on a bed of straw in a manger, while his mother and Joseph kneel beside him. The humbleness of the place is shown by the straw-littered floor of earth and the thatched roof. The lamb carried by one of the shepherds symbolizes the purity of Christ's life.

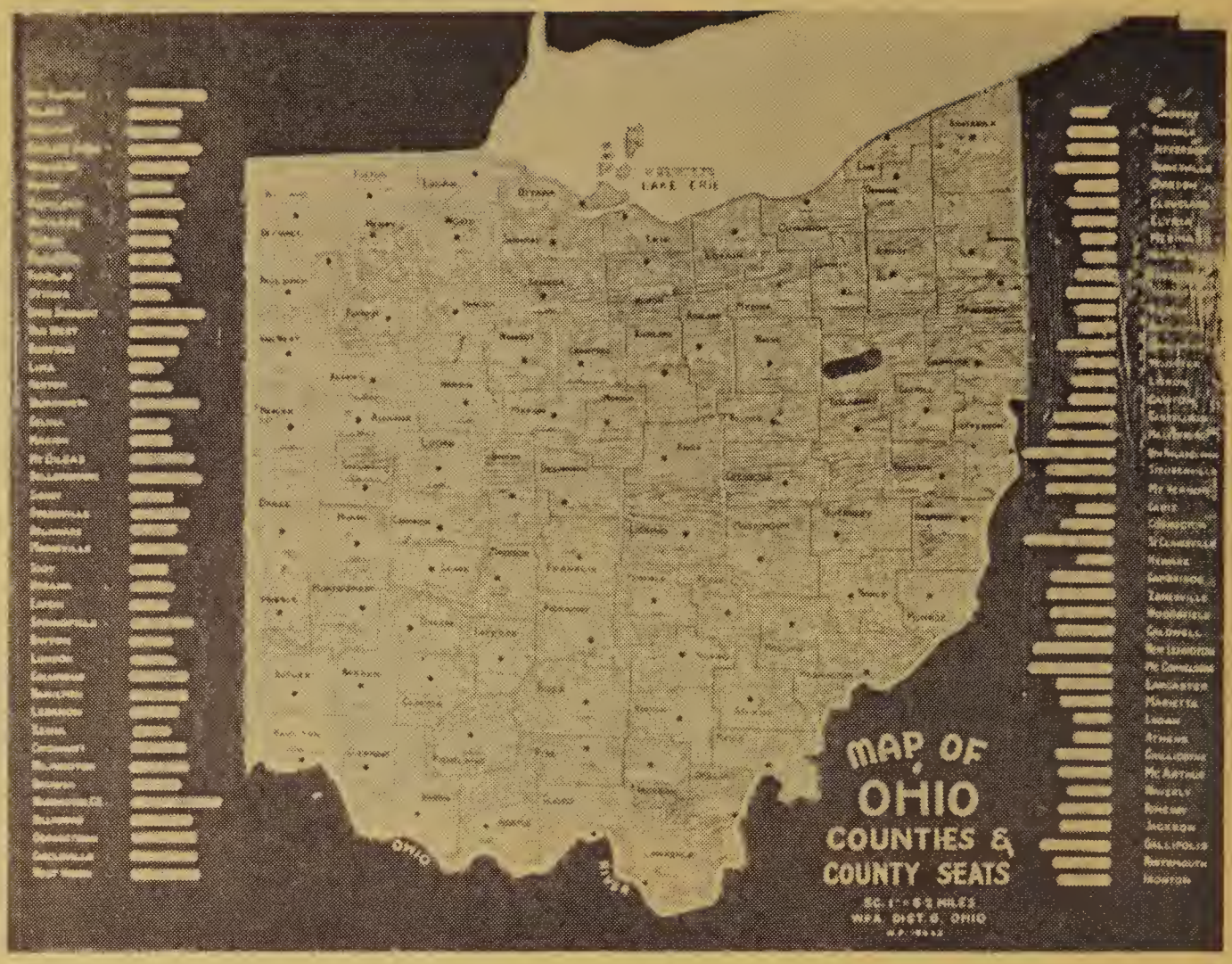
The model is a reproduction of Pierrey's picture, with the exception that the infant is in a cradle instead of in the arms of his mother.

THE LAST SUPPER

Leonardo da Vinci began his masterpiece, *The Last Supper,* two years after Columbus discovered America. It was a fresco painting (on wet plaster, becoming part of the dry wall), placed on the wall of the refectory of the Convent of Santa Maria della Grazie in Milan, Italy. This fresco has suffered greatly from scaling, but the painting still imparts a quiet, spiritual air to its surroundings. Monks at their meals may well have been gravely pensive in the presence of so reverent a theme in the hands of the great da Vinci.

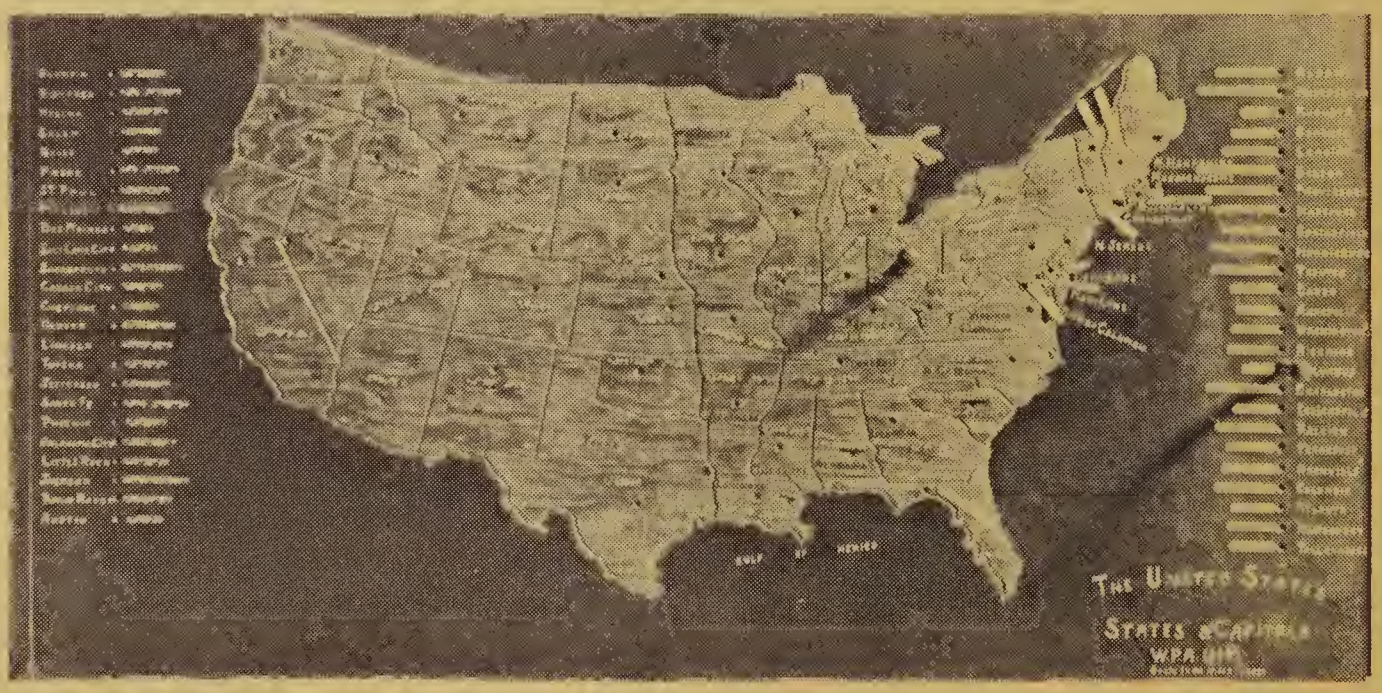
The faces of the 12 Disciples mirror the mingled feelings of passionately loyal followers who have just heard their Master say, "One of you shall betray me!" Judas sits greedily, guarding his bag of silver; in his excitement, he has overturned a dish at his elbow. From left to right, the Disciples are Bartholomew, James (the younger), Andrew, Peter, Judas, John, James, Thomas, Philip, Matthew, Thaddeus, and Simon. Bartholomew, young James, Thomas, and Philip stand. Christ sits in the center, his figure outlined against the mysterious light of evening as it falls upon the mountains seen through the windows of the far wall.

The model is a bas-relief of the painting; it is molded of a plastic composition to give a sense of depth.



OHIO MAP (ELECTRICAL)

Width 59½", Height 49"



UNITED STATES MAP (ELECTRICAL)

Width 5'6", Height 3'4"

ELECTRICAL MAPS

The electrical map models consist, in the main, of large maps constructed of one-quarter inch plywood. Boundaries are grooved in the wood so that they can be easily traced by a finger. In the United States map, the position of each State capital is marked by a mallory jack inserted in the plywood and wired to an electric buzzer. A list of State names appears in Braille on brass plates running vertically at each side of the map. These, likewise, are wired.

To acquire accurate knowledge of names and geographical locations, the child manipulates the plugs at his disposal — one for the State and one for the State capital. If a plug is placed in the jack at Charleston, capital of West Virginia, and the other plug is inserted at Columbus, no response is obtained. However, if the first plug is placed in the Ohio jack, a connection is made and a loud buzzer sounds.

The United States map is similar to the one constructed of Ohio and its 88 counties and county seats. The principle of construction and use of the two maps is identical. For instance, the placing of the plugs in the Columbus and Franklin County jacks, making a connection between the county and its county seat, will result in the acknowledgment, by buzzer, of the correctness of connection, just as in the large United States map a connection between a State and its capital will result in the same sound.

The county names are listed at the side of the map in Braille. Boundary lines, as in the United States map, are grooves in the wood.

GEOGRAPHY

USING A RELIEF MAP

Length 37½", Width 43", Height 3"

RELIEF MAP

Although exact as to the number and arrangement of blocks, name and location of streets, and location of important buildings, this model should be considered a pictorial diagram rather than a true-to-scale replica. However, it serves its purpose better than a scaled model. Distance can be approximated by counting blocks and streets, although, in order to accommodate the Braille name plates, some streets had to be made wider than the city blocks.

Whole blocks of the residential area and some parts of the business section have been made of thin pieces of wood to simplify the map surface and to emphasize essential features, such as names and directions of streets, location of outstanding buildings, and relationship of one particular area to another. The pieces of wood representing especially important buildings are made to resemble them in contour, and their heights are in proportion to the heights in residential areas. Each of these structures bears a number plate in Braille, which is explained by the legend in Braille that accompanies the map. In one corner of the map will be found a wire arrow, lettered to denote East and West, North and South.

The railroad tracks run at ground level; vehicular traffic is carried over them at the High and Fourth street crossings by means of viaducts. The Civic Center is on the high east bank of the Scioto River between Long and Town streets. Central High School is built on what was formerly bottom land in the bend of the river. It is said that Indians who camped where the State Penitentiary now stands and on the high land between Mound Street and Livingston Avenue raised corn just south of the site of Central High School.

It would take 81 models of this size to show the entire city of Columbus.

GEOGRAPHY

MAKING A PRODUCT MAP

PRODUCT MAPS

This group of maps facilitates classroom presentation of geography and natural-history material. Each map is a copy in relief of the familiar type of map designed to show percentage of production or distribution by geographic areas. For instance, if the legend reads, "each dot represents 10,000 bushels of wheat," a brad, which is the dot, represents the 10,000 bushels of wheat.

Made of plywood, encased in a moulding, each map measures 18 by 24 inches over all. Boundaries are outlined with 18-inch-gauge brass escutcheon pins. These pins form a line, three-eighths of an inch high, around such areas as individual States or the entire United States. Small black brads have been used to represent dots of distribution; each one signifies a certain quantity of the product shown.

Although the present supply of these maps is limited to the material found in classroom geographies, such maps have a much wider potential usefulness. Products now shown include wheat, tobacco, corn, cotton, swine, and dairy cattle.

Of special interest to anyone contemplating making gesso maps or maps of paper mache are the results of the trial given these two types at the Ohio State School for the Blind. It was found that papier mache maps could not be duplicated with a degree of accuracy sufficient to give each pupil a map uniform with all the others. An added fault was their lack of durability. The bands of paper that made up the map came loose with continued handling. Gesso maps, while practically indestructible, were still more difficult to make uniform, and, whereas the papier mache maps were too light to be durable, these were too heavy to handle easily. To date, the most successful maps have been of plywood, with nails and brads to mark boundaries, geographical divisions, and products. These are light, easy to handle, easy to repair, and much cheaper to make.

NATURE STUDY

ANIMAL PLAQUES

FISH PLAQUE

BIRD PLAQUES

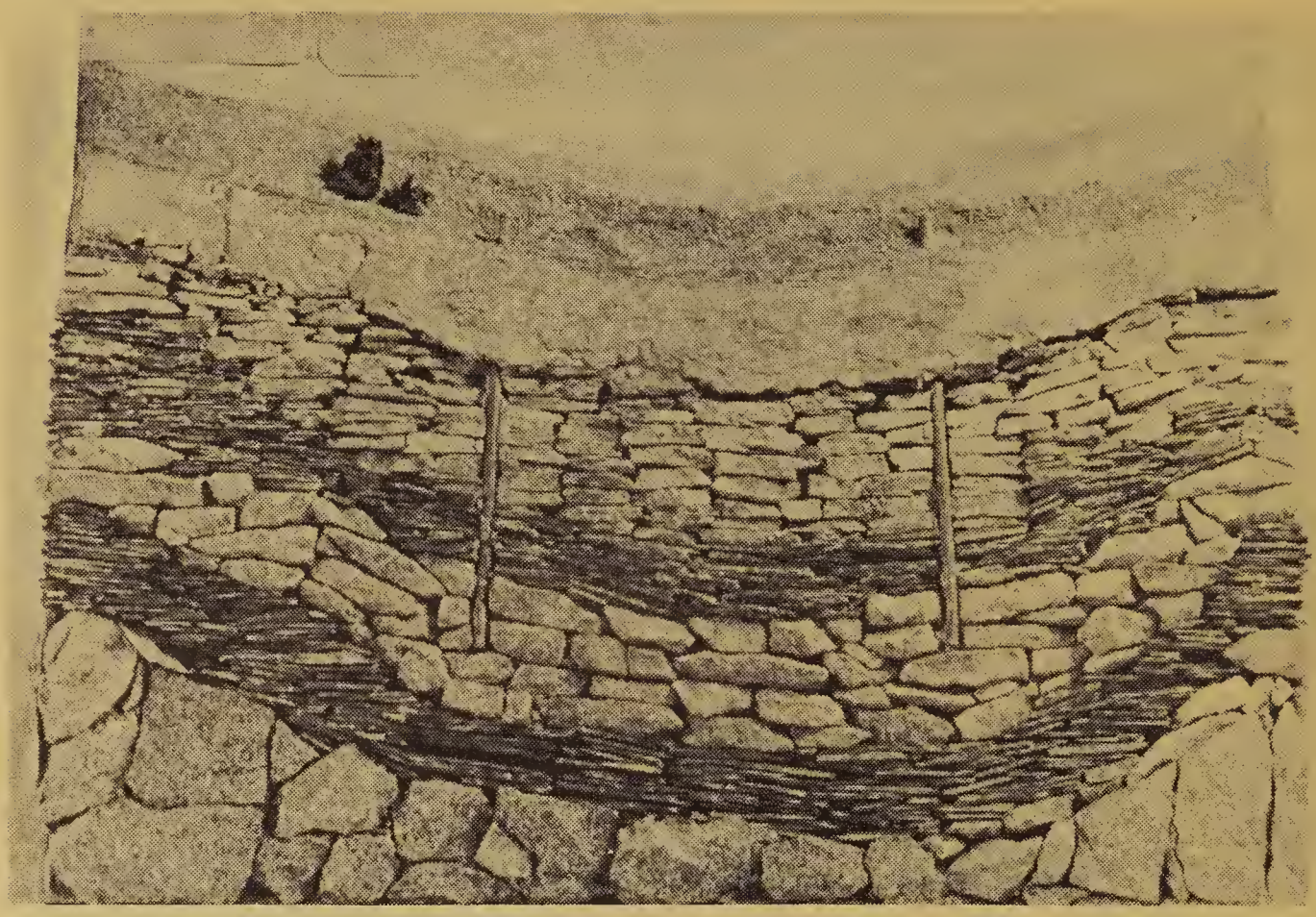
ANIMAL, BIRD, AND FISH PLAQUES

A series of plaques has been prepared, featuring rodents, birds, farm animals, and fish. These are of various sizes to suit their use in the classroom, and have been made of gesso or modeling clay mounted on a solid board backing. None is so large as to be unwieldy, and none so small that the features are not clear and distinct. The rodents pictured are the mole, field mouse, house mouse, rat, and chipmunk. The domestic animals include the sheep, cow, horse, hog, and white leghorn hen and rooster. Among the birds are the robin, crow, bob-white, blue bird, swallow, purple martin, wren, cardinal, red-headed woodpecker, downy woodpecker, English sparrow, Baltimore oriole, and song sparrow in its nest. The excellent series of fish plaques treats the bluegill, yellow perch, sunfish, or "punkinseed," pike, carp, crayfish, channel catfish, brook trout, crappie, and small-mouthed bass.

It has been remarked that the wild-bird and animal plaques seem large, but, according to the best authority, they have been properly scaled. They appear larger than life size simply because we usually see these creatures from a distance. The white leghorn hen and rooster are scaled together, and the domestic animals grouped to a reduced scale.

Although plaques could no doubt be used to real advantage in visual aid classes their use in instruction for the blind is not satisfactory. The absence of depth makes it impossible for the blind student to comprehend relative proportions. All models of this sort are now being constructed in three dimensions.

NATURE STUDY



ARTESIAN WELL

Width 24", Height 17"

ARTESIAN WELL

There is a continuous flow of water from a typical artesian well because the source of the underground water lies in higher ground. Boring a hole in the porous rock through which the water flows results in a steady flow to the surface, provided there are layers of hard rock beneath to prevent the escape of the water elsewhere. An ideally situated well is shown in the model. There are outcroppings of rock strata on the surface, and the wells have been drilled in the depressions between them.

The word, *artesian,* is derived from Artois, a province in France where such wells were drilled as early as 1750. The first people to dig wells, however, were probably the Chinese, who were drilling for water long before the Europeans thought of the idea. In 1838, wells in the London basin were giving six million gallons of water daily. The first well of great depth in the United States was dug near St. Louis from 1849 to 1864. A flow of 75 gallons per minute was obtained at a depth of 2,200 feet. At Denver, Colorado, the force of water in wells was great enough to lift it to upper floors of buildings. By 1916 all wells in Denver had to be pumped. Though the deepest well in the world, one at Leipzig, Germany, taps its supply at 5,735 feet, a well at Pittsburgh, Pennsylvania, is 4,675, and one at Galveston, Texas, 3,000 feet deep.

Although the presence of minerals is often easily noticed in artesian wells, the water is very pure for drinking purposes; for it is strained through the porus rocks underground. All artesian wells have small borings, and, though the term was originally applied only to free-flowing wells, pumped wells are now also called "artesian." The water of artesian wells is sought in regions where surface water is of doubtful quality or insufficient quantity. Many small cities and towns obtain their water supply from a system of wells. This type of well is also used for irrigation purposes and for the operation of air-conditioning plants.

NATURE STUDY

EROSION CONTROL

Length 27", Width 18", Height 6"

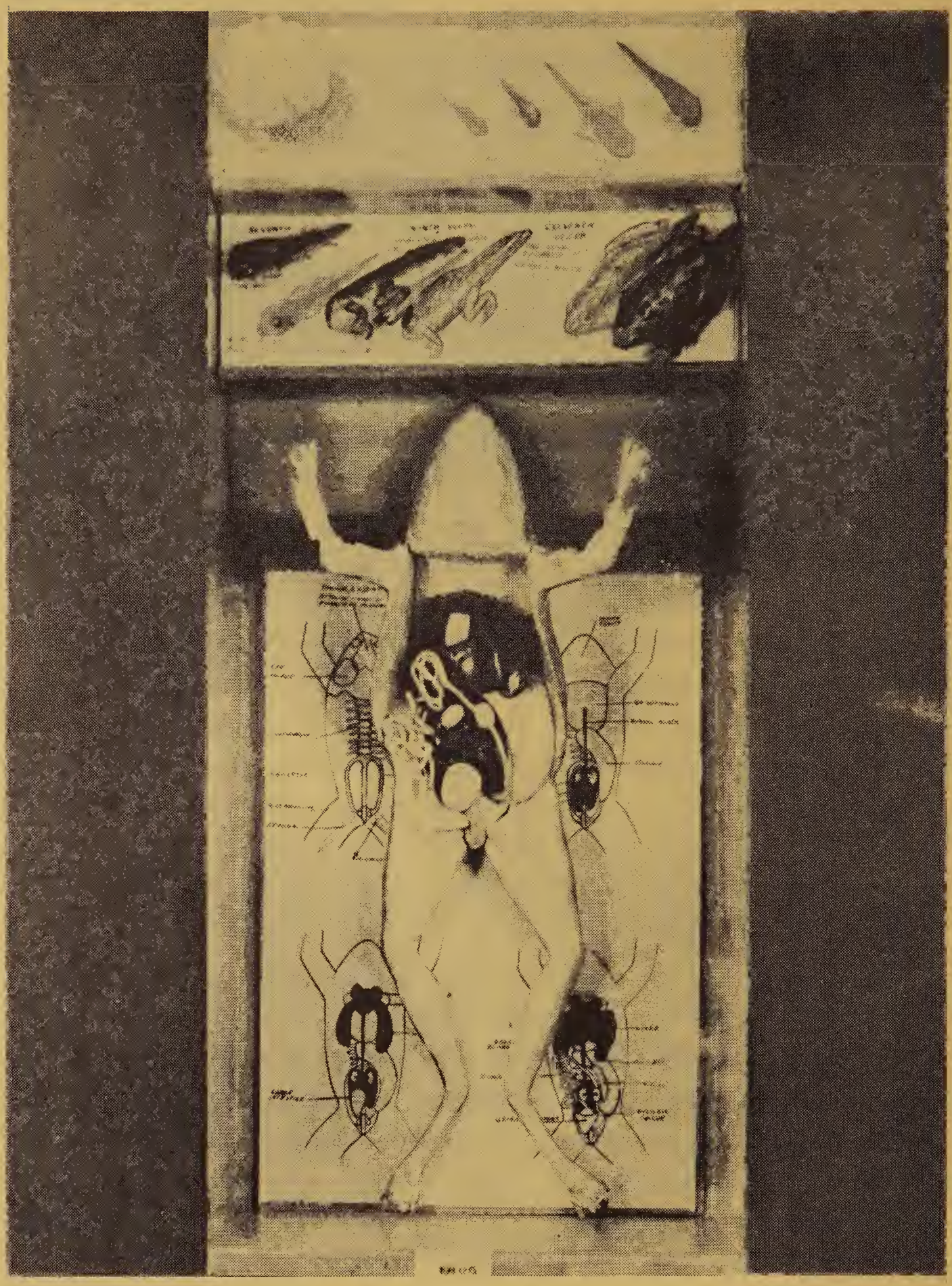
EROSION CONTROL

There are five common methods of erosion control in use in the United States today. In some sections, one or two methods are enough to combat successfully the washing away of valuable top soil; while in other localities, it has been found imperative to employ all five. Top soil is the most fertile of all soil, and the most important constituent of top soil is humus. Without humus, moisture quickly dries out of the soil; plants do not grow; there are no root systems to hold the soil, and it washes away with every rain. With humus, moisture is retained, plants grow, root systems hold the soil, and the decayed vegetable matter from the plants replenishes the humus as it is used up. No amount of artificial fertilizing will produce a soil equal to that produced by nature's own methods.

Strip cropping holds soil from washing away with each rain by providing belts of growing crops at all times, with no great area ever open to erosion at one time. Cover crops, grown in seasons when no regular crops are planted, protect the soil from wind, snow, and rain. Hillside terracing is one of the oldest, and perhaps the most widely used, method of erosion control. Reforestation of lands not valuable as crop lands provides tree belts that are natural barriers to wind and water and are beneficial to lands roundabout. If properly managed, a timber belt can be made to yield a cash crop of lumber. Contour farming is a way of keeping marginal land in cultivation by suiting the crop to the particular kind of land, whether it be hilly or level. It requires careful planning and watching.

The model shows five ways of treating deep gullies to close them up so that these methods can be given a chance. A series of dams or terraces of earth, logs fastened together to form a dam, boulders piled up into a dam, a ground cover of vegetation, and posts bound together with wire or wire fencing are shown. All may be employed as a sort of "first aid" to eroding land.

NATURE STUDY



FROG

Length 13", Width 5½", Height 4"

FROG

There are six complete changes in the growth of a frog from the egg to the adult. This story is told in a model of seven different parts, which can be stored away neatly in a glass-covered box.

The eggs are shown in natural size as they appear from the first to the fourth day. On the fifth day, external gills form. This and the succeeding stage in the development of the tadpole is shown by a model four times the natural size. The next part of the model illustrates the changes up to and including the eighth day. The gills in this model have been extended, so that their characteristics can be noted.

By the seventh week, hind legs have begun to grow, the gills have been absorbed, and the lungs have begun to function. This section and the next two sections of the model are three times the natural size. At the ninth week, the hind legs are fully developed and fore legs are becoming evident. By the eleventh week, the tail of the tadpole has been almost absorbed, and the practically adult frog is ready to leave the water.

A full-grown frog has four legs, with four toes on the front feet and five on the hind feet. The hind legs are very long and muscular, to permit the frog to leap from place to place. The feet are webbed, so that the frog may swim well. Though frogs pass most of their time in the water or in moist places, in dry weather it is often necessary for them to set out overland in search of water.

The seventh, and last, part of the model shows a fully developed adult frog in natural size. It is arranged so that the internal anatomy can be studied.

NATURE STUDY

LIFE STAGES OF A BUTTERFLY

Width 16½", Height 24"

BUTTERFLY

The eggs of butterflies consist of a membranous shell containing a fluid mass comprising the germ of the future caterpillar and its liquid food supply. Eggs are spherical, conical, cylindrical, barrel-shaped, or turban-like. Their surface is variously ornamented; sometimes ribs, looking like the meridian lines on a globe, run over the outside. In color, the eggs may be brown, blue, red, yellow, green, or the common greenish white. The female shows remarkable instinct in selecting the plant on which to lay her eggs so that when the larva, or caterpillar, hatches, it will have the proper food supply. The eggs are deposited singly, in clusters, or in a mass.

When the time arrives for the caterpillar to cut its way into the world, it makes an opening in the top or sides of the egg and emerges a segmented, worm-like creature. The first segment is the horny head with mouth parts and feelers. On the underlip is the spinneret, through which the silk is secreted to spin the cocoon. The skin lies in wrinkled folds, allowing great freedom of movement. The three segments back of the head correspond to the thorax in the adult butterfly, and the remaining nine to the abdomen. On each side of the rings are openings, known as spiracles, through which the creature breathes. There are three pairs of forelegs. The four pairs of false prolegs on the abdomen disappear in the last moulting.

Attaching itself, with a button of silk, to a branch, stone, or other projecting surface, and cloaking itself in a cocoon, the caterpillar enters the pupa, or chrysalis, stage. Study of the structure of a cocoon shows it to contain all parts of the confined butterfly slowly taking on adulthood. Some butterflies are in this state a few weeks; others pass whole winters this way.

Breaking its outer covering, the insect emerges as an imago, the intermediate form, with small, flaccid wings and undeveloped sense organs. Hanging from a twig or clinging to a rock, the insect fans its wings until all the organs and the wings are filled with blood. This process is very rapid. Liquids of the body are used up, the abdomen becomes small, and the rings harden and set. With its fully expanded wings, the creature can now soar away. Eyes of the adult butterfly are compound — that is, they are made up of many little, six-sided eyes, each receiving a separate impression. The organs of smell are the antennae, which project from the head like horns. In most butterflies the abdomen is shorter than the hind wings. The adult butterfly always has four wings, each of which is more or less triangular in shape. In the wings there is a framework of double horny tubes — the inner tube filled with air, the outer tube with blood. As the butterfly reaches the emergence stage, the circulation of blood in these tubes is almost entirely suspended. The actual membrane of the wings is covered on both sides with myriads of flat scales of beautiful color and diverse form. They rub off easily when touched.

NATURE STUDY

MT. VESUVIUS

Length 46½", Width 37", Height 9"

VOLCANO (CROSS SECTION)

Length 37", Width 28", Height 3"

VOLCANO

The plaque showing the cross-section of a volcano depicts the processes causing its formation. Volcanic eruptions are caused by increased pressure from the sinking ocean floor. As this pressure is augmented, the heavier limestone crust of the earth is bent upward into an arch, under which the softer shale rocks are crushed together, filling the dome-shaped cavity. Temperatures increase rapidly toward the earth's interior; at a depth of several miles, shale rock is kept from melting only by the enormous pressure from above. When this pressure is removed, as in the formation of a limestone arch, and the heat caused by crushing added, soft shale rocks actually do melt, making a pocket of molten lava in the fold of the crust. As the pressure continues to increase, a crack is eventually produced in the limestone, through which lava is forced out upon the earth's surface. Thus, a volcano spouting molten lava has been created from soft, but solid, rock.

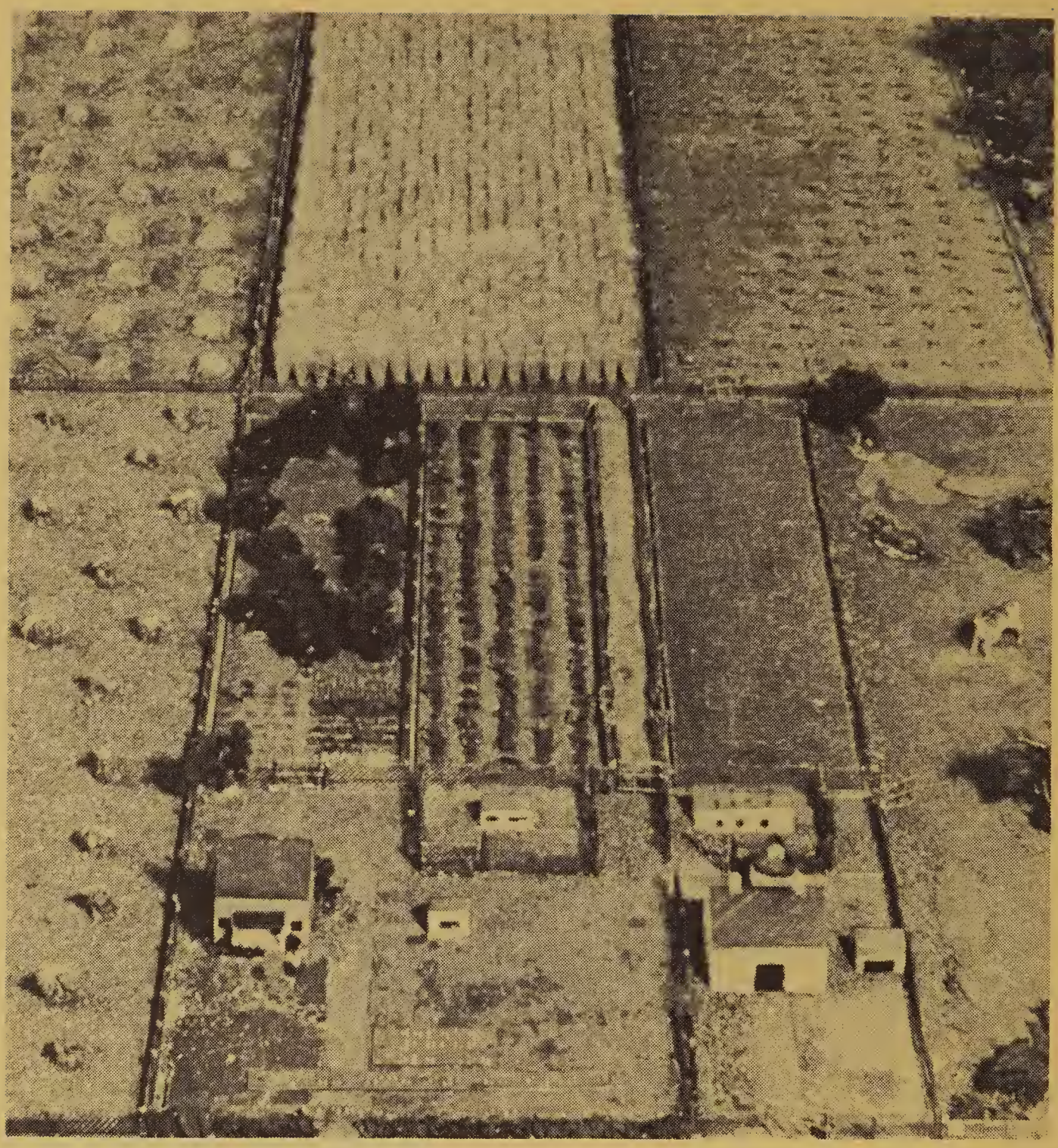
The dark vapor issuing from the crater of a volcano is not smoke, as is commonly supposed, but steam mixed with dust and powdered pumice. There can be no smoke, because nothing combustible exists for long in a volcano. As the escaping lava and steam pour down the mountain side and cool, they form new crusts of hard rock. Exploration of active volcanos is dangerous, because the deadly gasses that hang above the crater extinguish all life in their vicinity. (However, crumbling, decayed lava beds of extinct volcanos make fertile soil.)

One of the most famous volcanos is on Mount Vesuvius near the Bay of Naples. Misenum, Herculaneum, Stabiae, and Pompeii were ancient cities built at the fertile base of Vesuvius, for the Romans did not know that this mountain was an active volcano. When the volcano erupted in 79 A.D., it is said that a strange-looking cloud, shaped like a pine tree, rose suddenly above the mountain. As the people stopped to gaze, it changed shape continually and was sometimes streaked with black. Earthquakes shook the land, and the sea drew back from the shore, to return as a mammoth tidal wave. Dust and ashes hung in the air for days. Historians state that ash showers descended on far-away Africa and Egypt.

Though most of the populace escaped, many were trapped, or chose to remain and were later found dead. The elder Pliny, a famous old Roman in command of the fleet at Misenum, was killed by the gas and fumes. The newly crowned emperor hurried from Rome to supervise relief measures at the scene of the tragedy.

Towns close to the mountain were completely covered with a thick layer of mud and ashes, except for the tops of the tallest buildings. As the years went by, the top lava became fine loam, and vegetation sprang up, covering the places where the cities lay buried. We are still learning about ancient life by digging into the buried cities around Vesuvius and studying the remains preserved there.

NATURE STUDY



OHIO FARM

Length 60", Width 36", Height 3"

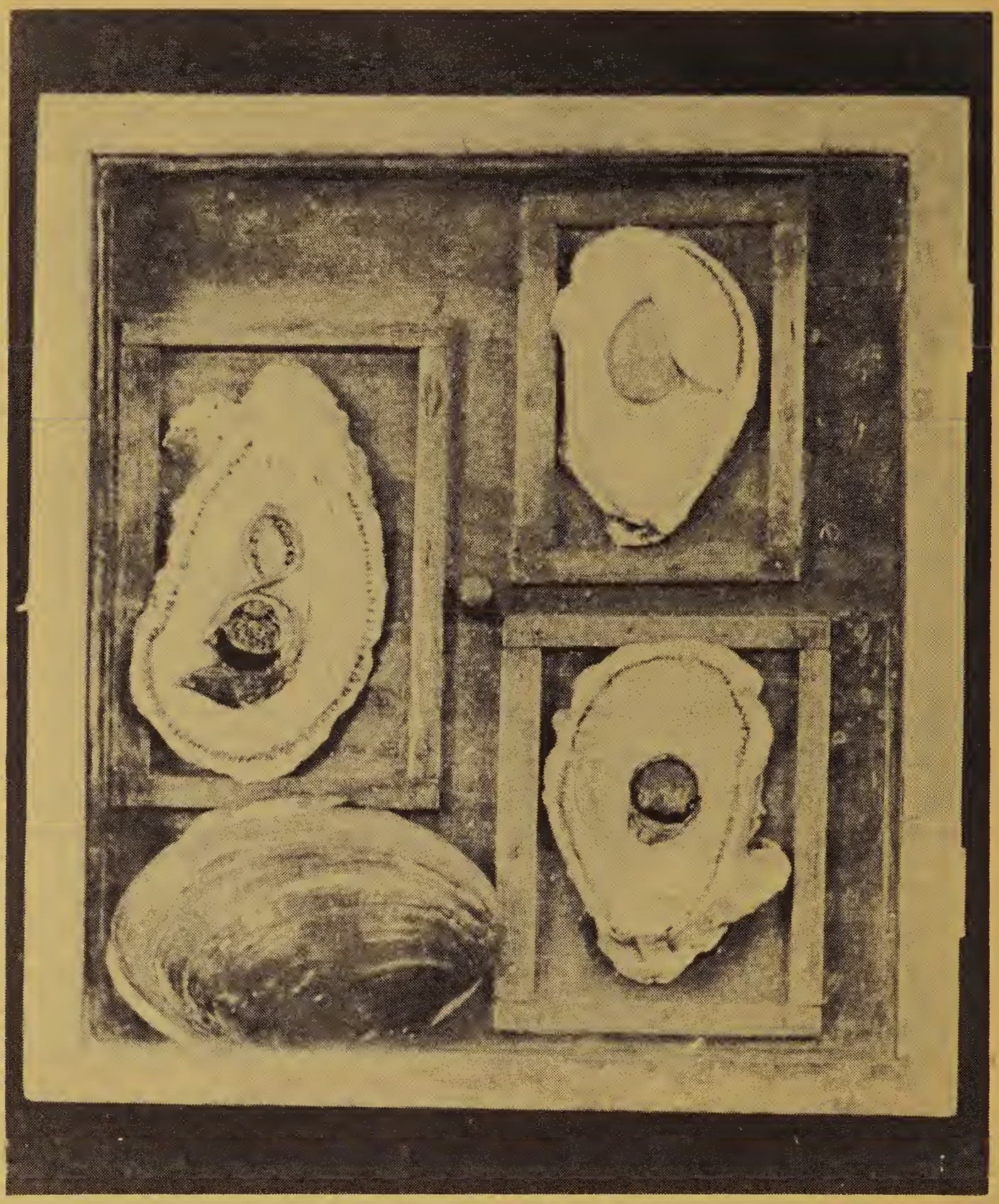
OHIO FARM

Ohio is one of the leading agricultural States in the Union. It produces large grain crops — corn, wheat, oats, rye, and barley. Potatoes are also grown successfully. Soy beans and cowpeas are raised for stock feed; and alfalfa, timothy, clover, and bluejoint are grown mainly for hay and pasturage. In order to increase the production of his farm, the farmer must constantly fight such noxious plants as wild oats, wild mustard, plantain, and jimson.

The miniature farm model represents the layout of a typical 80-acre Ohio farm. It is early summer, perhaps the first part of July. The wheat has been harvested, the oats will be cut within a few days, and the corn is knee high. There are four fields, which can be removed and interchanged to demonstrate crop rotation. The hay field is in doodles, the wheat field in shocks, and the corn field in plants; uncut grain is ripening in the oats field. One end of the woodlot has been thinned out, and several trees in the pasture offer welcome shade to the farm animals on long, hot, summer afternoons. The cows frequently stand, at noonday, in the cool stream that runs through the pasture. Since the owner of this farm raises quite a few horses and cattle, the narrow field between the tilled land and the pasture land is planted in alfalfa to feed the livestock.

Across the lane, the farmer has very wisely sown a "cash crop" — potatoes. Next to the potato field is the apple orchard; the part nearest the house is used by the farmer's wife for her vegetable garden. Farm buildings shown are a five-room farmhouse, one-car garage, poultry house, hog house, circular covered crib, barn with silo, and manure carrier and pit. Buildings and fences were built on a larger scale than that of the fields because otherwise they would have been too small for practical classroom use.

NATURE STUDY



OYSTER

Length 11", Width 11½", Height 3½"

OYSTER

This model consists of a glass-enclosed box containing various sections of an oyster. The first cross-section shows an oyster with the left half of the shell removed and a part of the mantle thrown back to disclose the gills at the place where the water currents are allowed to enter. The sieve-like gills comb the water for the microscopic plant life eaten by the oyster. The second cross-section shows the right half of the shell removed and the mantle entirely stripped away, displaying the gills and the soft body of the oyster. The third cross-section, from the same side, shows a deeper cut through the body of the oyster, the internal organs being laid open for study.

NATURE STUDY

SNOW FLAKES

Length 3", Width 7½", Height 7½"

SNOWFLAKES

Water vapor in the atmosphere is changed by the temperatures it encounters into dew, rain, hail, or snow. When the vapor goes through a process of slow freezing, it forms crystalline flakes called snow. To the naked eye, snowflakes appear to be all alike, but, when viewed through a microscope, they are seen to be made up of many beautiful crystals of a star-shaped pattern. Usually, the star-shaped crystals are six-pointed and have all manner of variations of delicate filigree between the points.

The largest snow crystals are formed during periods of rapid temperature change; the smallest, during periods of coldest weather. Maximum size for a snowflake is an inch in diameter; smallest is less than a grain of sand. There are no two flakes exactly alike, because, in forming, each flake passes through various strata of temperature, alternately liquifying and crystalizing as it is blown about, until the original simple crystal becomes a complex flake rather than the solid ice known as hail.

Upon striking a warmer stratum of air, the crystals already set are melted; as soon as they strike another freezing air current, the liquid solidifies once more. Thus the crystal line patterns of snowflakes are arranged and rearranged constantly as they fall earthward. A winter snowstorm purifies the atmosphere just as a summer rain; both carry to the ground the tiny dust particles in the air.

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INDEX

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